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COOPERATION

COMPARED with the experience of some of the older oil-producing states, Mississippi has an enviable early oil history. Ten years ago it entered the ranks of oil-producing states. It has already attained a place among the leading states in oil production despite the fact that seven of the ten years since oil was discovered a World War was in progress. In accomplishing what it has in development of its natural oil resources in a short decade, oil development has been orderly, efficient, and conservative. Wide spacing of wells is generally followed and the compilation of valuable reference data on field development is an important part of operating routine.

Full advantage has been taken of the experience of older oil-producing states in applying rules and regulations covering oil production. Mississippi has a high average output per well. It has the greatest average depth per well of any oil state. In 1947 it showed the largest increase in production of any oil-producing state. It has a relatively high percentage of oil recovery. It has applied, where possible, the very latest in modern production practice. It was drawn wisely from the ninety years experience of the United States in oil-producing operations.

Why the progressive trend in early oil field development in this state? Part of the answer is to be found in the fact that a cooperative group was formed five years after the first oil well came in. "The Mississippi Oil and Gas Engineering Committee was established and development was recorded and studied to determine the best engineering practices for the state." The history of this Committee is outlined in an article elsewhere in this issue. Its formation and successful functioning are a tribute to the high degree of cooperation that prevailed among operators. Concerted action of this kind with respect to oil conservation and the operation of reservoirs on a cooperative and unitized basis is essential and a fillip to progress in the industry.

Cooperation of Mississippi state officials with the industry in promulgating laws and regulations governing oil production has also been an important factor in the state's attaining what it has in oil. By adopting oil regulations that experience has proved successful in other states, Mississippi has had an advantage of efficient oil development that has led to the conservation of its resources. The state has also reaped great social gains that are a by-product of a more adult industry. Instead of the undesirable conditions that, in the past, have accompanied oil booms the oil development in Mississippi has aided in better living within the whole state. This has come about through the employment of some 4000 persons, through large company expenditures, and through the payment of substantial taxes. Here is a heartening object lesson in cooperative development by a state, an industry, and operators within that industry.

K.C.S.

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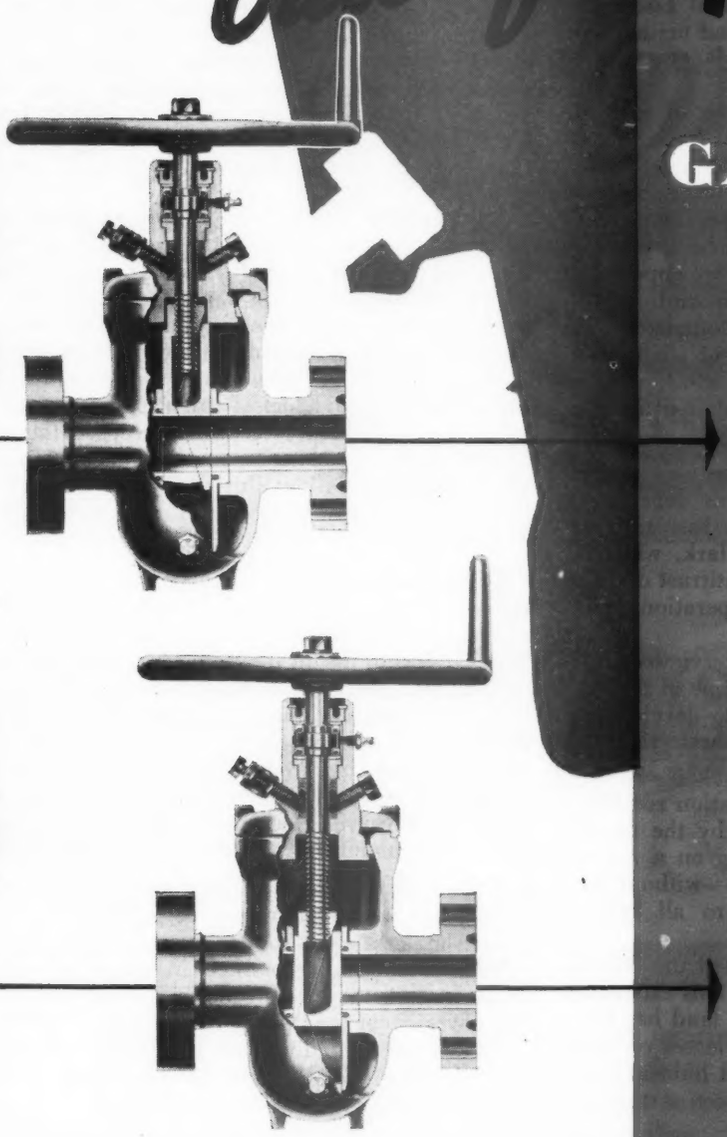

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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—Settlement of the tidelands oil issue probably will be delayed until the Supreme Court rules next year on the new suits against Texas and Louisiana, now that the compromise talks have failed and neither side has the votes to put across either a state or federal control bill.

Speaker Rayburn (Texas) had high hopes of working out a compromise. And he probably would have, except that Texas politics muddied the waters—until it was too late.

In the meanwhile, Attorney General Clark was nominated to the Supreme Court and lost interest in the compromise talks. And Interior Secretary Krug began to back water as word reached him that President Truman was opposed to any compromise involving federal ownership and control.

Now, Krug is back on Truman's side, completely. He favors nothing less than full federal control of offshore oil development. It is unlikely that Congress would pass a federal control bill now. And quitclaim legislation is a forlorn hope. So, the stalemate is on again.

▸ **Pipe Lines.** Whether the Department of Justice's revived pipe line investigation will be continued now depends on the new attorney general, Harold McGrath. Just after his nomination to the Supreme Court, Tom Clark, while attorney general, gave the green light to his antitrust division to make a field investigation of pipe line operations, both crude and products lines.

Three antitrust attorneys went out and interviewed independent marketers, refiners, and producers. One of the government lawyers let drop that they hoped to develop evidence for pipe line divorcement suits to separate the lines from oil company ownership and control.

▸ **Oil Leasing Policy.** Failing to get legislation requiring competitive bidding on all lands acquired by the federal government, Interior Department is working on a revised regulation to accomplish a similar objective—without congressional approval—which would apply to all federal lands, public lands as well as acquired lands.

Assistant Secretary Davidson has instructed the Bureau of Land Management to prepare new regulations cancelling any oil and gas lease application where the land has been proved up since the application was filed; leases on such areas would then be auctioned to the highest bidder. However, since this news leaked out, there has been a storm of protests, particularly from independents.

▸ **Gas.** Enactment of the bill exempting independent producers from Federal Power Commission's control seems unlikely at this session, especially if Congress winds up soon. But proponents of this measure believe that Senator Kerr (D, Oklahoma) stands in so well with President Truman that it has a good chance of passing next year. Meanwhile, the Senate Commerce Committee is delaying action on the renomination of Leland Olds to the FPC until hearings are held. A bitter fight looms, if Olds' nomination ever reaches the Senate floor.

▸ **Refiners' Plight.** Chairman Patman (D, Texas) of House Small Business Committee is sympathetic with the plight of independent refiners, convinced that they are being "squeezed" with product prices falling and crude prices steady—but he doesn't believe that this situation comes within the scope of the present investigation of oil imports.

▸ **Import Hearings.** Congressman Keogh's oil import subcommittee plans another swing through the oil country—not yet visited—to hear from state officials and producers how the domestic industry is being affected by imported oil, but it probably won't be until October or November. Hearings may be held at Jackson or New Orleans for Mississippi, Louisiana, and Arkansas; at Oklahoma City; at Casper, Wyoming, or Denver; and perhaps at Los Angeles. One reaction the subcommittee has so far is that American producers may have more to fear from Canadian competition than from the Middle East.

▸ **Synthetics.** The Bureau of Mines hopes to finish its comprehensive study of petroleum in time to submit to Congress early next year. Its purpose, apparently, is to show the "need" for legislation authorizing the building of commercial-size synthetic fuels plants. This report will discuss the relationship of petroleum and synthetic fuels, analyze data on exploration, development and reserves, and discuss utilization of liquid fuels (which is another way of saying "end use"). Secretary Krug has accused the oil and coal industries of "blocking" congressional action on his synthetic fuels legislation. But the real truth is that Interior doesn't want the bill to come up until this petroleum study is completed.

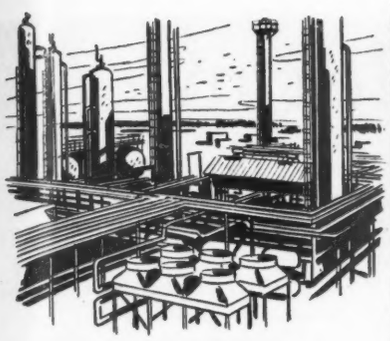
▸ **Oil Agreement.** Many independent producers are worried over vague reports out of London that the British hope to enter into some kind of oil agreement with the United States in lieu of the oil treaty now gathering dust in a Senate pigeonhole. Among the subjects reportedly suggested for inclusion in such an agreement were control of production, allocation of markets and fixing of prices. Of course, such baldly-worded aims would draw objection from the Department of Justice, if not the State Department. Many independents, however, feel that these reports confirm their worst fears about the Anglo-American Oil Agreement.

▸ **British Oil Threat.** In their private talks with officials here about ways and means of getting more dollars, the British make it clear that they expect to increase their oil shipments into dollar markets including the United States, itself. In fact, they would like a definite commitment from our government for this country to take a specified amount of British oil annually. Also, the British would like American companies to buy sterling oil to supply American markets in Europe.

It has been suggested that, as an alternative to losing their markets completely, American companies should be allowed to market in some non-dollar areas provided that most of the money from such sales were spent for British goods and little, or none of it, converted to dollars.

A straw in the wind was the State Department's recent questionnaire to American companies asking what would be the absolute minimum amount of dollar exchange needed from their sales in non-dollar areas.

▸ **ECA.** Several of the leading American oil companies marketing in Europe have been called in recently by the Economic Cooperation Administration for an "explanation" of price differentials existing among European countries participating in the Marshall Plan. Apparently, ECA believes that American countries should not charge more than the "low" of published quotations for the American Gulf, plus actual freight.



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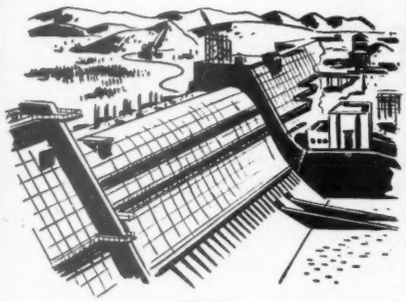

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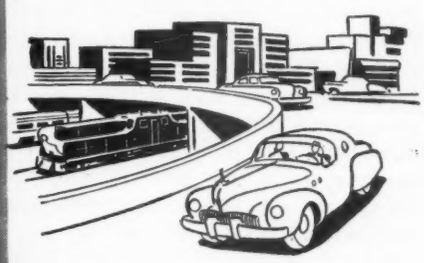
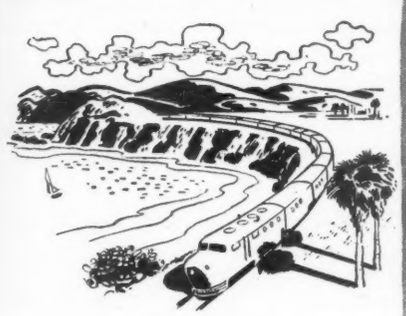


HIGHWAYS



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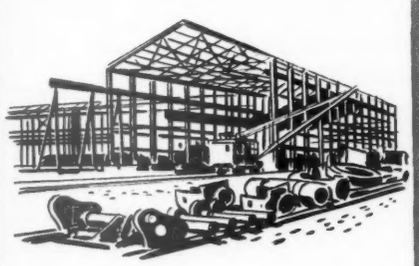

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Highlights in Oildom

Russia Reports Output Doubled. According to the Russian Embassy in Washington, Russian crude oil production now is slightly more than double that of 1945. Production increased 12 per cent in 1946 compared with 1945, 21 per cent the following year, and 18 per cent further in 1948, and currently is running 12 per cent above last year, the report has stated. It also noted that the drilling of oil wells has been speeded up, but did not say by what means. Other reports from the embassy have stated that Soviet oil workers last year and so far this year offered more than 30,000 "rationalization" proposals and inventions, of which 22,000 "have found broad application in the oil industry."

Hold Field-by-Field Hearings. The Texas Railroad Commission will hold field-by-field hearings to obtain the information necessary under the state's new gas-measurement law. Representatives of gas-transmission companies and major oil and gas companies have already met with the Commission. Previous to this meeting, landowners and independent producers met with the commission. The important question is the method to be used by the commission in arriving at the temperature and pressure figures that a "standard cubic foot of gas" will be calculated. Under the new law, "a standard cubic foot of gas" is defined as the volume of gas contained in 1 cu ft of space at 14.65 psia and a temperature of 60 F. When conditions of pressure and temperature differ from this standard, conversion is to be made in accordance with the Ideal Gas Laws, corrected for deviation. The new law becomes effective October 5.

States Attack Tidelands Bills. Texas and Louisiana have attacked seven major points of difference between the two tidelands bills introduced in Congress, by Rep. Francis E. Walter. A House judiciary subcommittee is attempting to reconcile these differences between the states and the federal government and combine the two measures into one that will set forth the policy to be followed in the administration of the offshore oil resources.

Objection No. 1 by the states is the provision that at any time the federal government can reserve all or any part of the tidelands for its own use in the interest of national security. Second objection is the demand by the government that the states pay it all moneys received from the tidelands since June 23, 1947, the date of the Supreme Court decision in the California case. Another objection is that the Great Lakes are not included in the definition of inland waters and quitclaimed to the states. State officials are heartily opposed to the Interior proposal that the maximum acreage one person can lease is 128,000 acres in wildcatting territory and 30,000 acres in proved fields. They claim this limitation will restrict free enterprise. State officials question the fairness of the provision in the government bill that the states will not have the right to sue the federal government to determine their claims to the tidelands, although the federal government will have the right to sue the states.

And final objection to the bill is the provision that lesses of the states will not be authorized to continue to pay rents and royalties to the states until the federal government's claims to the tidelands have been determined by final court action.

Bill to Cancel Refiners Premium. The only thing needed to wipe out the premium payments the Interior Department has been collecting since 1947 on royalty oil sold to independent refiners under the O'Mahonev Act is President Truman's signature. Under this act, small independent refiners with no assured sources of crude were given a preference in buying royalty oil from the public lands. Oil was put up at auction and went to the bidder of the highest premium over the posted price.

Harsh Oil Law. As a result of recent legislation passed in Guatemala, further exploration work seems unlikely in that country by private capital. Under the new law, all equipment imported into the country for drilling, construction, or any other purpose would become the property of the government, and any company obtaining production would be required to build a local refinery to meet the country's domestic needs. Also, any petroleum exports would be under the strict control of the Instituto National de Petroleo, a government agency. Under the new law, maximum acreage for exploration is about 81,000 acres, with leases provided for half that amount when production is obtained. Royalty is 12½ per cent of net profits, increasing to 15 per cent when the initial investment is dissolved. Provision for fines up to $100,000 for violations of contracts or of the law, are incorporated into the new law.

This legislation is further representative of Guatemala's unfriendly attitude toward foreign capital representing major companies.

British, U. S. Officials Meet. The subject of international oil markets is being discussed in Washington this month by diplomatic officials of Britain and the United States. Purpose of the discussion is to set up a common oil policy between the two countries. The discussion is a part of the dollar crisis meeting between U. S. Secretary of the Treasurer, John W. Snyder, Britain's Chancellor of the Exchequer, Sir Stafford Cripps, and Canadian economic officials. The dollar crisis in England has brought the oil situation to a head, as Britain has been resorting to deals that threaten to drive American oil companies out of various markets, in order to save dollars.

Proposes Oil Policy Council. An oil policy council may soon be set up, if Representative Oren Harris (Dem.) of Arkansas' bill is passed by Congress. The council would include representatives of the Interior, State, Commerce and Military Departments, and the National Security Resources Board. It would coordinate, clarify, and recommend policies to assure adequate petroleum supplies of satisfactory quality at reasonable prices for both war and peace. Recommendations would be made to Congress on necessary legislation.

Production Allowables Set. Coming in on a crest of optimism in the oil industry, higher allowables were set this month for several oil producing states, and top oil officials are of the opinion that the oil industry's outlook now is the best it has been this year. Although Texas' new allowable of 2,077,905 bbl daily, is 639,114 bbl below that of last December, it is still a 132,268 bbl increase over last month. Kansas will be producing 10,000 bbl more this month than last, and Louisiana's maximum allowable will exceed last month's daily output by some 6517 bbl.

This first raised allowable, following seven months production curtailment orders in Texas, means three things to oil producers: (1) The price of $2.65 a bbl for top-gravity Mid-Continent crude oil is "safe," at least temporarily, (2) demand for crude oil is picking up, and (3) stocks of aboveground crude oil and heavy refined products, which have been top-heavy are coming into balance. The big question, as yet unanswered, is how long this increased demand will last. Major oil company officials are of the opinion that the bottom has been hit in oil demand, and from here on out, the demand will be upgrade.

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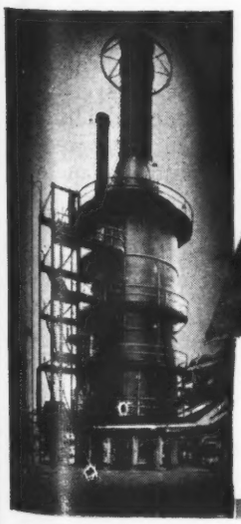

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Jackson Petroleum Club, which would seem to be a fairish load for any normal individual, but he also holds the vice presidential spot at the Jackson Country Club. In spite of these sizable responsibilities, he still has enough time to devote to other interests and excitements, particularly horses, of which he has an exceptionally fine stable. Every fall he gets inextricably involved in the Mississippi State Horse Show and it is an involvement that he really loves. In any case he addresses himself as earnestly and vigorously to the success of this event as he does in his efforts to expel an obstinate ball from a difficult sand trap when he is with his favorite foursome.

Divoting

Another high class manipulator of the mashie is Reece Oliver who is reputed to have won more money on the golf course than Sea Biscuit ever won on the race course. Reece is a perfectionist who, as soon as anything goes wrong with his game, takes steps to correct it. When he finds himself topping the ball, he simply tees it with the other side up. If his swing goes haywire he studies it in front of a mirror—as long as the mirror lasts. When he is inclined to hook he studies slicing under some reliable surgeon. They say he has developed a gadget for determing the force with which a driver strikes the ball when a driver strikes the ball. And all this scientific concern and manoeuvering appears to be a worthwhile investment if one will merely listen to the groans of his opponents.

Ike LaRue, on the other hand, is one of the most consistent payer-offers in the Jackson area. Indeed, there are those who never expect to pay for their own laughing aqua as long as the genial Ike is around. It doesn't make much difference where an oil assembly convenes—at the Country Club or the Petroleum Club—there Ike is to be found dispensing with a liberal hand. These two institutions have become the popular rendezvous of the petrolic elite who there find surcease from their labors in the blessedness of tinkling ice, air conditioning, and subdued conversation.

Casting

One of the most influential among the influential folks who constitute the oil industry in this part of the world is Duke Davis. Here is a fellow so thoroughly respected by oil men in his own state and those who know him outside of his own state that it is no wonder he was made a Duke. However, in spite of his high rank, he is just as human as ordinary people, and there are hosts of people who are proud to call him friend. E. B. McGehee is another disciple of Izaak Walton who gets a bang out of sharing good times with his family and friends. His lodge on Camden Lake, 40 miles above Jackson, has been the scene of some mighty interesting outings, and the Squire McGehee has convinced many a skeptic that here is the finest place in the state for angling—whether one is angling for a good time or for fish. Across the lake from the McGehee cabin, and within hailing distance are the hideouts of Buzz Morgan and W. D. Mansell—another pair of popular Mississippi operators. Buzz, incidentally, publishes a weekly summary of drilling activities in Mississippi, Alabama, and Florida, under the name of the Dixie Geological Bulletin.

Not too far from the McGehee lodge on Camden Lake also is another hostelry that is well and favorably known to many oil men in the vicinity of Jackson. This is the property of Tip Ray of Canton, or Mr. Tip, as he has become widely known. The place is named Tithelo, and Mr. Tip has entertained so often and so generously here that the word Tithelo has almost become synonymous with the ultimate in good fellowship. Closing the enviable record of this much to be envied part of the petrolic scene, we say a last word for Red Shelby, an independent operator whose observations on the industry and its techniques are regarded always as gems of understanding; and A. H. Stone who, in an entirely unobtrusive but nonethless effective way, helps Hall Wallace and the State Tax Commission to retain the goodwill of the petroleum operators of Mississippi.

Mr. Hush Hush

Now, from Arch Foster comes an SAE advance publicity release that in our humble opinion is the sort of thing of which international incidents are made. The piece was apparently sent out by John Warner from SAE's New York headquarters, and without a blush it announced that American and Canadian automotive engineers were *fathering* in Portland, Oregon, on August 4, 1949. Personally, we think that intimate information of this type should not be permitted in the public press, but on the contrary should be exchanged only in whispers—and very subdued whispers, too—in the privacy of one's boudoir. Also, we don't mind saying that up to the moment we received the copy of this blatant bit of boastfulness we had been laboring under the delusion that automotive engineers were a rather respectable lot.

One of these days, when we have a talk with Junior about the birds and bees, we are certainly going to make sure that in addition he is adequately warned about the SAE's. The whole thing comes as a nasty shock to a trusting soul who has always liked to think well of people.

Gazelle-Hunting

Veering briefly now to the far west, we sat in with the elite of the export world at the L. A. Jonathan Club a short time ago and spent an interesting couple of hours with Frank Gilstrap, representing five companies—and he'll name them: Tom Martin—Bob Eiche's front man; Earl Rees of Patterson-Ballagh, leaving shortly for Mexico, Venezuela, Trinidad, New York, and other distant parts; John Flanagan and Norm Andrew—the M. O. Johnston technicians; Herm Paschall, the H. C. Smith repatriate; Paul Medearis and Bob Engle of the Medearis interests; Jay Failing and his new export manager, Ole Olesen; and last but by no means least, Frank Gilstrap's guests, that interesting father and son combination—the Ridgeways.

Ed Ridgeway, Standard of California drilling foreman out on the Murphy-Coyote lease at La Habra, was born in Campbell, Missouri, but migrated to Kern River about 1915, in time to tie in with Standard, under the direction of John Daley. In the meantime, he has done some exploring of foreign fields, particularly in the Dutch East Indies, where for a time he was drilling foreman for the Nederlands Pacific Petroleum Company. At the moment he is the proud proprietor of a 20-acre Yorba Linda orchard, to which he will repair if he ever grows old, which is doubtful. Right now he is almost as young as his son, Connie, who by a strange coincidence is drilling foreman for Aramco in Saudi-Arabia. Connie was born in Bakersfield, did a little oil work here when he grew up, and then in 1944 went to Abqaiq. He is at present vacating in California and will try to get in a round or two of golf while he is here. Being a modest soul he merely claims to be a "slight" golfer, which is refreshing after the way the home boys boost their own divot-lofting stock. Over yonder in Saudi-Arabia, Connie gets in a bit of hunting once in a while for gazelle, and tells us that duck, dove, and quail also abound in the neighborhood of Abqaiq. He states that the secret of gazelle-hunting success is to aim so as to hit the animal if it is a gazelle and miss it if it is a cow.

Wherewith we close, remember that the most humiliating thing about a vacation is that when you come back hardly anyone knows you have been gone.

At a Humble well near Natchez, two local negroes dig auxiliary mud pit with mule team. *Courtesy Standard Oil Co. (N. J.)*

P 111.18

Mississippi — *The Oil Mystery*

ERNESTINE ADAMS*

MISSISSIPPI is a pleasant land of huge magnolia trees and small cubist hills, of spacious ante bellum mansions and crowded Catfish Row. Its young oil industry has also been infused with such contrasts, some of which have grown into puzzles or paradoxes. In other words, Mississippi just isn't like any place else.

Modern exploration methods have been rebuffed by the complexities of Mississippi's deep and ancient geologic formations but no field has been discovered without geological and/or geophysical work. Random drilling has produced dry holes and very little information.

On the other hand, Mississippi fields average higher output than the fields in any major oil-producing state; individual wells also average greater oil production.

Mississippi's daily average production of 125,000 bbl in 1948 was only slightly under that of Wyoming and New Mexico, but Mississippi produced from 21 oil fields counting one field with one well and two fields with two wells each; Wyoming and New Mexico each had more than 100 producing fields. During the same year Mississippi wells averaged about 90 bbl a day production compared to 59 bbl for neighboring Louisiana, 22 for Texas, and 8 bbl for each Oklahoma well.

The fact that Mississippi wells average more footage than in any other state is offset by as simple and easy drilling as you'd find anywhere and

EXCLUSIVE

*Managing Editor.

costs are about the same as the U. S. average despite greater depths. Considering the depths involved, costs run some 30 per cent below average.

So, though the odds do not favor the operator, the stakes are high in Mississippi and the oil industry has proved its belief in the state's potentialities by heavy expenditures in leases and exploration and development. Mississippi is beginning to pay back the investment. Oil and gas output last year brought gross sales of more than $110,000,000, twice the value of any previous year. Production showed the biggest percentage gain of any state in the Union. Texas, Louisiana, and Oklahoma were the only states with a larger volume increase.

This is a striking achievement for a state that has been in the oil business just 10 years this month. It is still a greater achievement when you realize that this has been no Spindletop boom. Mississippi has had the most orderly and conservative development of any oil-producing area in the U. S. It has had the advantage of development by an older and more experienced oil industry that works with better judgment and more ethical competition than in those early day booms.

Mississippi, sometimes unfortunate in other economic branches, has been lucky in oil.

Background

There is some question about the first test to be drilled in Mississippi. It had been generally conceded that this was in 1903 when the Alabama-Mississippi Investment and Development Company drilled a well to 1842 ft in Clark County near Enterprise.

Recently M. P. Bouslog of Gulfport reported in the Mississippi Oil Review that he and several associates put up $12,000 and drilled to 1800 ft about a mile from the Gulf in 1901 and 1902.

At any rate drilling began around the first of the century, but Mississippi was a reluctant oil state. It was almost 40 years and more than 540 wells later when the first commercial oil well was drilled.

Two encouraging events came during this long dry-and-abandoned period. In 1926 gas was discovered near Amory in Monroe County. The field didn't amount to much; only three producers were completed. It lasted 12 years, however, supplied nearby towns, and produced close to 2 billion cubic feet of gas.

Of greater significance was the discovery in 1930 of a gas field by the Jackson Oil and Gas Company close to the city of Jackson. As early as 1860 Eugene Hilgard, state geologist recognized the Jackson structure and mentioned it, then in 1916 the "Vicksburg-Jackson" structure was pointed out in a U. S. Geological Survey bulletin by Oliver B. Hopkins. There were numerous attempts to tap the favorable structure but it was 14 years after the bulletin was published before the gas strike at Jackson Dome. This was much larger than the Amory field and provided the capital city with gas for many years. It has produced some 116 billion cubic feet despite haphazard development and loss of much gas from existing practices. A small amount of gas is still being produced.

The field came at a strategic time for the town and the state. It sweetened the '30's depression, providing a new cheap fuel for the state capital and bringing in some much needed tax money. Production reached a high of 9 billion cubic feet for the first half of 1939 and has dropped rapidly since to virtual abandonment.

The Land and Who Owns It

Mississippi's land and leases and royalties have a wide and varied ownership. Out of 47,716 square miles, Federal land is mainly some 4340 square miles of forest reserves and the state has a school section in each township and several state forests and parks. There are more than 14,000,000 acres left for private ownership and harassed landmen will tell you that every one of the 2,400,000 Mississippians own at least a little plot of land, although half of them are Negroes, considered an under-privileged race. The land men have statistics on their side. Only Texas and North Carolina have more individual farms. There is one farm in Mississippi for every 9 persons.

To add confusion to multiple ownership, the Federal Land Bank recovered farms for loans during the depression of the 30's and for some reason sold leases. This move particularly affected the Piney Woods country, which has had the greatest oil activity recently.

There is little activity in the northeast part where the Tennessee Hills have the highest elevation in the state, (maximum 806 ft). Hard rock is reached at about 2000-5000 ft and the coarse formations demand large quantities of drilling mud. The small Amory gas field is the only discovery in the area.

In the flat, swampy Yazoo-Mississippi Delta are the large, rich plantations with a few oil fields at the southern edge. Tinsley and Pickens were good fields, and are still producing large quantities of oil. Cary field has been abandoned and Flora is a field of 4 small wells. This was the scene of the first development in the state and the spotlight has passed farther south.

From the northwest, low-rolling hills come down to meet the sharp loess formations in the eastern rim of the delta and the tidal meadows far to the south on the coast.

The Bluff Hills, as the loess is called, gives the country a perky, modernistic touch in contrast to the featureless wooded deltas and coastal plains. They are sometimes sharp and geometric, shaped like squares and rectangles, cones and pyramids. They border the Mississippi Delta from the Tennessee border to Louisiana.

See page A-22 for Mississippi map showing surface geology, oil and gas fields, pipe lines, and refineries. See page E-57 for table giving data on Mississippi fields.

One operator said they interfered with making exact locations. "When the hill is big enough to hold a rig you can't haul it up there and it's sometimes a tight squeeze to rig up in the narrow gorges between hills."

The loess was formed by wind-blown deposits from the flood plains of the Mississippi River until it was about 30 to 90 ft thick then cut by stream erosion so the sides are often vertical and cultivation of the rich soil is difficult.

Below Jackson in a wide belt that extends from West to East, from Natchez to Waynesboro and beyond is the Piney Woods country, once covered with long leaf yellow pine and now dotted with oil and gas fields and 42 proved salt domes.

After the lumber companies had largely stripped the Piney Woods it was left to the small farmers to make what they could of the stump-strewn land. They raised yams and water-

Since 1939 a new field or new sand has been discovered for every 20 wildcats drilled

	Wildcats	Total wells drilled	Discoveries, fields and new sands
1939.....	17	20	1
1940.....	103	208	1
1941.....	74	222	1
1942.....	51	92	0
1943.....	58	122	4
1944.....	72	203	9
1945.....	120	353	8
1946.....	82	275	8
1947.....	93	483	4
1948.....	110	426	5
1949(1st hlf).	54	151	4
Total	834	2555	45

melons and sold what garden truck they could to the canneries. At the same time they sold and traded oil leases and royalties to each other and to outsiders. Many a time it kept the mortgage holder and tax collector off the old homestead.

It is the landmen who are suffering now from this tendency to swap and buy and sell royalties down in the Piney Woods. When the Brookhaven field unitization program was put through, it wasn't like Wyoming, for instance, where a few owners, maybe only one, agreed to the project. A diplomatic corps of oil company representatives had to get signatures of some one thousand persons with ownership interests in the Brookhaven field. Most of them had never seen an oil well until shortly before but by the time unitization was working "gas-oil ratio" had joined "boll weevil" in the Mississippi vocabulary.

This diverse ownership is beneficial to individuals and to the state because it has provided some income for thousands of families and helped in keeping taxes paid up.

The oil industry also gains in the long run. The man who understands the industry's problems is generally friendly toward it, and in Mississippi the oil industry has been pushed into explaining itself to a lot of citizens.

Geology

Nothing is simple about Mississippi's geology. Ancient beds lie deep beneath a series of recent deposits that began in the Cretaceous period of the Mesozoic era. There is little surface indication of early eras. The oldest surface rocks, high in the northeast corner, go back to the Paleozoic era, but evidence of the Appalachian mountains, if they stretch into Mississippi, is covered over.

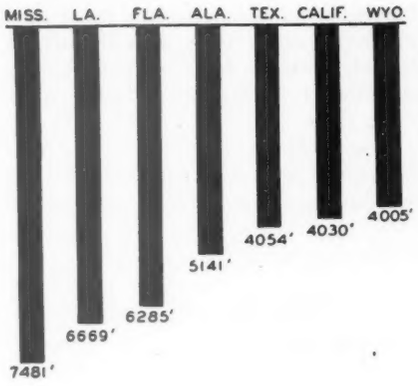
The north and south portions of the state were subjected to different submersions in ancient times, that sometimes overlapped each other. In the north an interior sea transgressed and retreated. In the south the marine waters of the Gulf extended northward and withdrew time after time.

The great glaciers of the North did not reach Mississippi, but floods from the glaciers overflowed into stream courses and deposits were left in Mississippi, especially in the delta, which comprises the west-northwest portion of the state.

This repeated inundation has complicated underground structures and then covered the complications with thousands of feet of deposits to add to the troubles of geologists and geophysicists.

The frankly puzzled oil exploration staffs commiserate with each other and wish for a 25,000-ft seeing eye.

"This is a case for the classical geologist," said one, "who gathered his data bit by bit to build a history that finally offered satisfactory conclusions. That's what we'll have to do here unless some genius shows up with a quick and easy method of locating Mississippi oil."



Average depths of wells in 1948 shows Mississippi wells are deepest of all the deep-drilling states.

TEN YEARS OF DRILLING

1939—First Oil Well

The Works Progress Administration, the Mississippi State Geological Survey, the Yazoo County Chamber of Commerce, and the Yazoo County Board of Supervisors were all back of a mineral survey of Yazoo County in 1938. William C. Morse, state geologist, was in charge of the project and his assistant, Frederic F. Mellen, was field director. In February, 1939, Mellen discovered the Tinsley Dome in the rough loess-covered area near Perry Creek.

The find was revealed in a news release on April 12, 1939, and just four and one-half months later the first well came in. The industry was luckier or more enterprising in following the Mellen survey than the earlier Hopkins survey that lead to the Jackson gas field. The time lag was cut by almost 14 years. Southern Natural Gas and Union Producing Company began taking leases in the latter part of April and others bought less heavily on the strength of Mellen's geologic report. Union Producing, an affiliate of United Gas Company, made a seismographic check of the structure and rigged up the G. C. Woodruff No. 1.

B. G. Barnes, Union drilling chief, was in charge of operations. No one was very excited about it, he recalls. You must remember the oil industry had drilled a lot of wildcat failures in Mississippi's history.

The state itself was still riding on the elliptic wheel of cotton economy, which had remained on the flat side through the long depression. Mississippi, with its half white, half black population, had too much trouble getting corn pone and turnip greens together to work up much interest in an ole drillin' machine.

On September 5 the Woodruff well was brought in from 4540 ft, making about 185 bbl of 35 gravity oil a day.

Then things got "hotter than a team load of hell."

Scouts were rushed to Mississippi from other states, especially by major companies who had little acreage in the state. Seismograph crews, gravity meter crews, magnetometer crews, rolled into the flat bottoms and over the loess hills.

The Mississippi Oil Scouts Association reported that acreage under lease had doubled by the end of the year—in less than four months—when more than 7,000,000 acres were covered. Leases ranged from the Cold Water River to the Singing River at Pascagoula; little land could be condemned by previous drilling, and the state had not been explored widely or uniformly.

1940—The Rush

In the mad scramble that followed, as many as 68 geophysical crews were in the state in one month and the oil industry drilled a generous 103 wildcats during 1940 and found just one field, Pickens, and only seven structures.

Most of the wildcats were in the north half of the state and geological and geophysical data were still meager, but many lease blocks were held only by drilling and dry hole money was not hard to find, so the oil industry drilled.

It must be remembered that both Tinsley and Pickens fields, the finds of 1939 and 1940, were vastly underestimated. Tinsley began with an 8 bbl an hour well and the first offset was dry but in 1947 the field joined the 74 in the U. S. that have produced more than 100,000,000 bbl of oil.

Pickens had a hard time getting started, too, but since 1943 it has been producing around 100,000 bbl a month from the Eutaw sand at 4830 ft.

Looking at the 1940 record had a sobering effect on the industry. Exploratory staffs saw that the smiling land was going to be tougher than it looked. The industry took a deep breath and slowed down. An effort was made to learn more before the drill went down. Hasty work and quick decisions had not paid off.

1941—Retreat

In 1941 the wildcats drilled numbered 47, reflecting a more wary attitude on the part of the petroleum industry. Results were wary, too. C. L. "Buzz" Morgan discovered what was later found to be an extension of the Pickens field. Union Producing went down to 5761-86 ft in the Tinsley field and found oil in the McGraw sand. The British-American Oil Producing Company discovered the only new field, the small Cary deposit between Tinsley and the Mississippi River. It produced about 60,000 bbl of 25 gravity oil from the Selma gas rock before it was abandoned in 1946.

1942—Salt Domes

The lowest point was reached in 1942 when geophysical work was heavy but results were discouraging. Leases were dropped and drilling was down. Drilling 51 wildcats found no oil or gas. Results were exactly two more salt domes to be added to the 7 salt domes already found, and until the present time no commercial oil or gas fields have been associated with one of Mississippi's salt domes.

1943—Bonanza

Bad luck seemed to be broken in 1943. First the California Company discovered the Brookhaven field in March. The Lincoln County find was 10,156-10,322 ft, or 166 ft in broken Lower Tuscaloosa sand. The first well pumped 157 bbl of 26 gravity oil, one of those not very encouraging discoveries that Mississippi is noted for. It was not until 1947 that any intensive development was carried on and in 1948 gas was piped from Gwinville to be injected in the field under a unitization plan. Today the field has a new gasoline plant also and produces about 450,000 bbl of crude oil a month from 147 wells.

In September Gulf Refining was pumping 158 bbl a day from 6666-86 ft in the new Eucutta field in Wayne County. This discovery was the first of Mississippi's faulted dome structures that hold low gravity oil deposits in the Eutaw sand and are marked by a depression between the faults, known to geologists as a graben. They are all good producing fields.

Love Petroleum Company found the small Flora field in Madison County.

The biggest discovery of the year was California Company's Cranfield field, near Natchez, the city of yearly garden club pilgrimages. The first oil was found in the Wilcox at 5742-5898. Later (1944) production of oil and condensate were found in the Lower Tuscaloosa below 10,000 ft and gas in the Paluxy sand at 11,722-90 ft. Cranfield was a rich find. Under unitized operation with a cycling plant it now produces more than a half million barrels a month from 94 wells and is considered a 100-million-barrel reservoir.

Yes, 1943 was a good year for Mississippi. The industry had drilled 58 wildcats and it had in return a small field and three big ones. No one realized how big then.

1944—Record Finds

Encouraged, the industry concentrated on exploration. Geophysical crews moved in again as they had in 1940. Only this time seismograph crews were favored instead of gravity. Core drilling crews scattered small centers of hurried activity over the peaceful countryside.

Seventy-two wildcats were drilled and Mississippi's best record of discoveries was made—9 new fields or new sands or only 8 wildcats for one discovery. Four of the new fields were big ones: Mallalieu, one of the largest producing areas, Heidelberg and Baxterville, low gravity reservoirs, and Gwinville, the big gas field that got its first transmission line in December, 1946. Two sands were discovered in both Heidelberg and in Gwinville.

Besides the Lower Tuscaloosa reservoir found at Cranfield that was to make it a big producing field, discovery wells were drilled at Bruinsburg, a salt dome near the Mississippi River, and Langsdale.

Bruinsburg is more an indication than a discovery. A small shallow well drilled for Sun Oil produced about a million cubic feet of gas daily from 935-45 ft. It is shut in. Langsdale is a small field clear across the state from Bruinsburg on the Alabama line. It has produced around a thousand barrels a day from the Eutaw sand (3535-3809 ft) since January, 1946. Kirby Petroleum found pay sand in late 1944 and completed the well in early 1945 so it could be in the 1945 discoveries.

Mallalieu is another deep Tuscaloosa reservoir near Brookhaven. California Oil Company's discovery well was a bare toe hold, one of those tantalizing clues that Mississippi hands out with seeming generosity. It took years to find the field after it was discovered and only in 1948 did it begin to show its producing powers. Each of the 99 wells in the field ran an average of more than 200 bbl a day of 38 gravity oil until they were cut back by the State Oil and Gas Board to 150 bbl per day per well for June 1949.

Heidelberg East and West fields over toward Alabama, were both discovered by Gulf Refining Company in 1944. It is an Eutaw and Upper Tuscaloosa low gravity oil reservoir with a central depression. Production has been cut in half in recent months because of low demand for heavy crude oil, but in the past the field has produced more than 15,000 bbl a day.

Gulf Refining also brought in Baxterville, down in South Central Mississippi a prolific reserve of low gravity oil in the Lower Tuscaloosa, making as high as 23,000 bbl daily in 1948 but held to 6000 bbl a day now because of markets. This was another of those discoveries that had dry holes left, right, and north before the trend of the pay formation was found.

In early 1945 Superior Oil Company struck an Upper Tuscaloosa formation at 7610-7912 ft in Baxterville that had gas and condensate. The field has a number of dual completions that produce from both reservoirs.

1945—Record Wildcats

Although the full extent of the 1944 discoveries could not be estimated, the industry had all the encouragement it needed. Core drilling crews were doubled. Geophysical work was a fourth greater than the year before and wildcat drilling hit its all-time high of 120 tests.

Results could be summed up in the name of one field of the year, Soso. Soso is a gas and condensate pool in the Eutaw at 6448-6710 ft discovered by Gulf Refining. It lies between Heidelberg and Gwinville fields.

Carthage Point, a gas and condensate field by the Mississippi River below Natchez, was the most important find of the year. It was discovered by The Pure Oil Company in the Lower Tuscaloosa. Hub, a Lower Tuscaloosa gas and oil pool, was found by Humble. It lies in the Pearl River Valley not far from Baxterville. Fayette, another Humble discovery, is north of Cranfield. Quitman, northeast of Heidelberg, remained a one-well field and was abandoned in 1947.

1946—Slowdown

The most important discovery in 1946 was the Wilcox oil pool at La Grange field in the vicinity of Natchez. Wilcox in Mississippi is not the same as in Oklahoma. It is in the Lower Eocene series, topped at 4619-42 ft at La Grange. The discovery well, owned by Sohio and Roeser-Pendleton, was another edge well and development was slow, but the field is now fourth in production in the state.

Kings gas field, discovered by Magnolia, is one of several one-well salt dome fields in Mississippi, which may be landmarks for future development. This one is above historic Vicksburg on the Yazoo River.

Pine Ridge, a Wilcox pool north of

Natchez was discovered late in the year by Phillips Petroleum and has 10 wells now that average more than a hundred barrels a day each.

Two new sands were discovered in the Hub field, and one each in Cranfield and Fayette.

The year showed a slowing down of exploration, leasing, drilling, and discoveries but it was also marked by significant extension at Brookhaven and Mallalieu fields and growth of production. There had been 86 wildcats drilled, with not very spectacular results to be sure. One one-well gas field, two small oil fields, and five new sands.

1947—Record Development

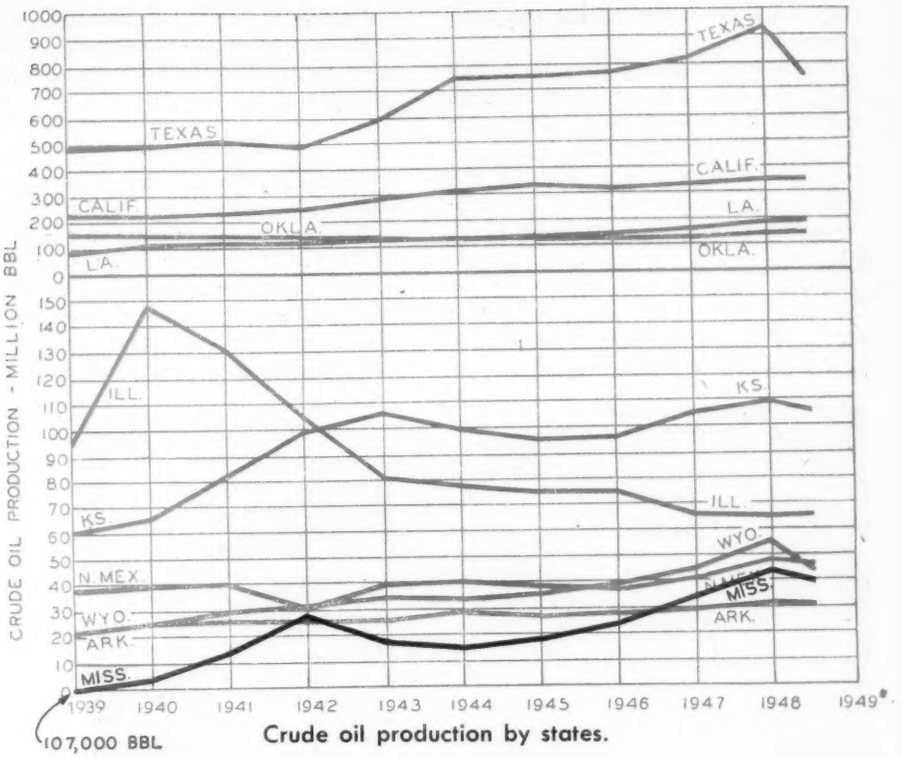
Geophysical work had dropped in 1946, but core drilling had increased. In 1947 all prospecting was cut. One reason was that a good part of the state had been covered by some type of exploration and another was dissatisfaction with poor reflection in seismograph work. Some geophysists think this is mostly a failure of interpretation methods.

This was a year of drilling, however. A total of 483 wells went down, 93 of them wildcats. Production spurted, rising to 35 million bbl of oil and 56 billion cubic feet of gas. Mississippi had the highest percentage increase in production of any state in the U. S. Big oil states Texas, California, and Louisiana were the only ones with greater volume increase. Little ole Mississippi had not only joined the march, she'd stepped right out in front, a drum major in hoop skirts.

The 93 exploratory wells, however, picked up only four new deposits. McBride, west of Fayette, is a shallow sour gas well on a salt dome and the one well is shut in. Sandersville, a faulted dome south of Heidelberg, was soon abandoned, Oldenburg has four wells producing from a very deep sand.

The only field that has been proved is the Yellow Creek field, discovered by Hughes and Sistrunk in December over near the Alabama line. It is a low gravity pool in the Eutaw at 4938-5218 ft and now produces more than 2000 bbl (May production 75,287 bbl) a day from 54 wells.

The most exciting well of the year was Superior Oil Company's Cassie Bradford No. 1, which established the depth record for Mississippi at 15,730 ft. It was a rank wildcat in Forrest County and was drilled tight; Superior really saw that no information leaked out. Two ambitious scouts tried, using camouflage suits they had in the army to get closer to the well but ran out of trees around the rig. When a report came one afternoon that a test was to



Crude oil production by states.

be run, the Tower building (mostly oil company offices) in Jackson emptied like magic but the regiment of scouts was turned back by a squad of roughnecks.

It was just like old times for a while until a couple of men injected a modern note by chartering a plane and seeing what could be seen from overhead. They admitted it wasn't much.

The well found oil below 12,000 ft and below 13,000 ft but not enough to pay to install pumping equipment.

1948—Record Production

Development continued to be more important than exploration in 1948. Out of 426 wells it is true that 110 were wildcats but this wasn't an unusually high percentage of wildcats for Mississippi. The big news was production. A 30 per cent increase of oil production was again the highest proportionate rise of any state. Only Texas, Louisiana, and Oklahoma were higher in volume increase.

Discoveries weren't much to brag about—at least not at the time. At Yellow Creek, Hughes and Sistrunk jumped over a piece scattered with dry holes and discovered East Yellow Creek field in the same sand at the same depth.

Gulf Refining found oil in a faulted dome structure at Ovett in Jones County, far off from any production and deepest in Mississippi. Oil is in the Lower Cretaceous with a range of production said to be over 1000 ft and reaching below 13,000 ft. It is still one well, running about 50 bbl a day of 31 gravity oil.

La Grange got a South La Grange addition drilled by Harry W. Elliott; both pools are in Wilcox sands.

Production was found toward the south at Sandy Hook on the Pearl River basin west of Baxterville field. Humble and Union Producing Company are the operators of this Tuscaloosa condensate pool.

One of the most interesting discoveries in a long time came at the end of the year. H. L. Hunt found good production of high gravity oil below 10,000 ft at Roxie, east and a little south of Natchez. Four wells have been drilled to this Lower Tuscaloosa and produce about 50 bbl each daily.

With the discovery of Bude by the Barnsdall Oil Company in early 1949, there was hope for three new Franklin County fields—Oldenburg, Roxie, and Bude, to develop into more and maybe better Mallalieus.

1949—Second Stage

This year's new fields and new sands and some good shows of oil and gas make the industry feel it's getting warmer. The constantly increasing number of drilling tests and the growth of geology and geophysical knowledge seems to be opening new reservoirs. Just to keep the oil industry in its place, however, the discovery at Bude was flanked by dry holes. As one geologist sketched it, the underground structure looked like a shmoo's head with the discovery well on the

eye and the offsets missing the head altogether.

Bude was followed by Sand Hill field, the first production in Greene County; the Ellislie field, named for the old Ellislie Plantation in Adams County; Wilcox production in the Oldenburg field; a Lincoln County discovery by Big Chief Drilling Company and W. B. Osborne; and a new Jefferson County field discovered by Stanolind Oil and Gas Company. Only time can assess the discoveries of the year but they look interesting.

Easing of crude oil demands and inauguration of new allocation regulations begins the second stage of Mississippi's development.

Engineering

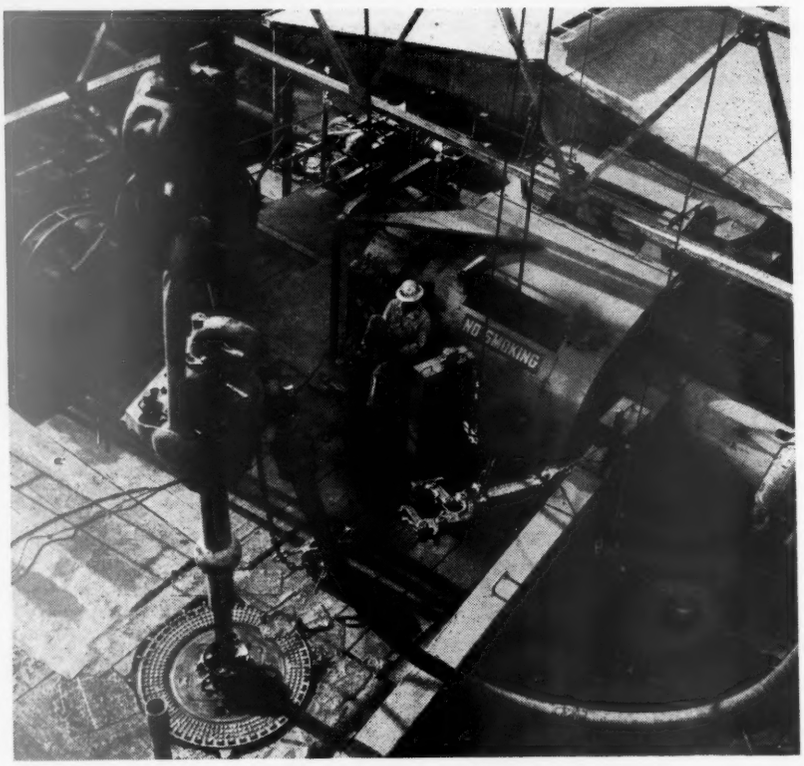
Oil and gas engineering problems may not have been so deeply puzzling as the exploration enigma in the new oil state of Mississippi, but there were serious questions concerning the efficiency of development and production operations. The war kept engineering staffs small and pushed production to the utmost to help meet the demand. Each operator had facts about his own wells but no general pool of information was available about the other wells in the field or the other fields in the states.

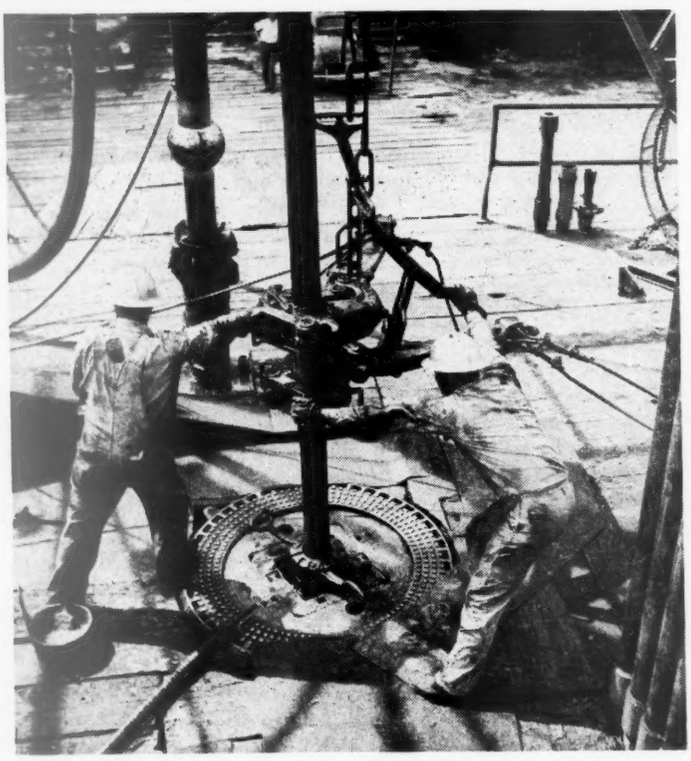
The only state oil and gas regulations had been drawn up principally to fit the Jackson gas field, and drilling and field practices and amount of production was left to the individual operators. Legislation to enact uniform rules and conservation measures found little fertile ground in the war years and later, when prices were high, the idea of regulating production affected the personal interests of too many operators and royalty owners who foresaw only a decrease in immediate payments.

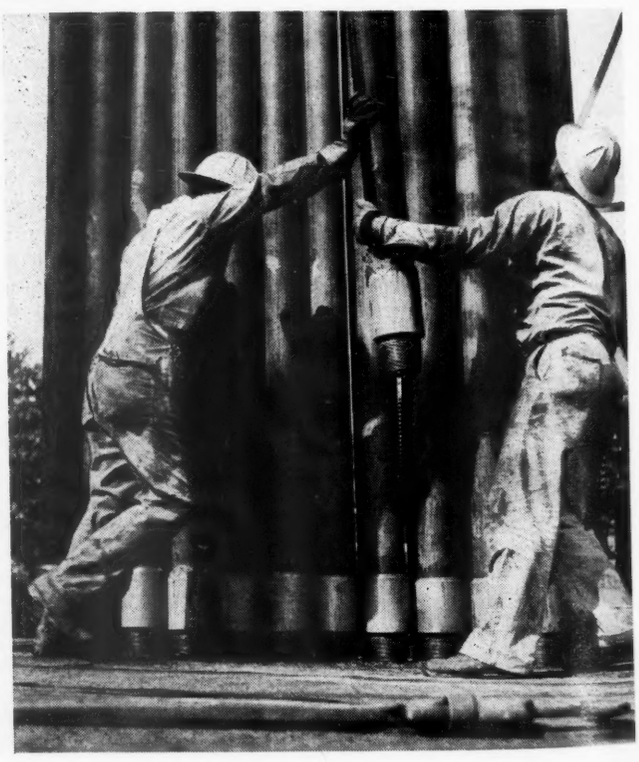
In the summer of 1944, D. V. Carter, chief petroleum engineer for Magnolia Petroleum Company, began working out a plan to share information. "Factual data are the principal constituents of an understanding," Carter wrote.* "Many of us have experienced the discovery that the solution of what appears to be a complex problem has a fairly simple explanation" when reservoir engineering studies are available.

The leading operators in the state

*Petroleum Engineer, July, 1946, Page 88.







Scenes at a rotary drilling rig near Natchez: Left, waiting to add another length of pipe; below left, bringing pipe out of hole; right, men racking pipe. *Courtesy Standard Oil Co. (N. J.)*

formed a Mississippi Oil and Gas Engineering Committee on a voluntary, non-profit basis to collect reservoir engineering data for its membership.

One result of this action of D. V. Carter and other top men in the industry was that Mississippi has the best documented oil development of any major producing state. Another is that Mississippi may very well set up a record for high percentage recovery of oil and gas from its reservoirs. With solid facts to build on and methods learned from long experience, Mississippi has a heritage of engineering know-how that older oil states have provided.

In 1948 Mississippi passed an oil and gas conservation act and a five-man board was established to carry out its terms. The Board took over the Committee's engineering responsibilities. This year the state joined the Interstate Oil Compact and is represented on the Commission by Governor Fielding L. Wright.

Drilling

One major problem in drilling in southern Mississippi is that of getting a rig in from Louisiana or Texas, a problem that will cure itself when the oil demand is strong enough. So far drilling operations have not been heavy enough for contractors or company departments to keep rigs handy for Mississippi locations.

It is not hard to get to a location, as Mississippi has a good modern highway system. Ed Kenna, now executive vice president of Mid-Continent Oil and Gas Association at Jackson, put in some 3500 miles of paved highways when he was state highway director, which has been a boon to oil development. A few corduroy roads must be built a short distance, such as in Adams County, but large difficulties have not been encountered.

"The soft formations are like going through custard," one operator declared. Another complained he could hardly beat the drilling report back to the office if he waited to see the surface pipe set. Rotary drilling is general and in some places wells almost supply their own mud.

Of course, that isn't the whole story, or even half of it. There are hard formations, even in the south, and diamond drills are used. Most of the drilling is deep. Mississippi has the largest percentage of deep wells of any state except Florida, which is a minor oil-producing state.

Deep drilling, no matter how lacking in other problems, requires big rigs, heavy equipment, and lots of pipe. Before the new highway system was built it might have been an unsurmountable problem to move this heavy machinery to swampy locations. With rotary drilling in a new and uncharted underground the operator needs to feel his way with continued logging and core testing.

Although the climate rarely interferes with drilling, Mississippi River floods sometimes stop or slow down operations at Carthage Point by covering the field with water.

Drilling is not as cheap as the easy drilling would indicate. Most operators thought $10 a foot was average, which is close to the average for the U. S. It is much less than the U. S. average of about $13 a foot, however, for deep drilling such as Mississippi has. It must be remembered, also, that a large proportion of the wells in Mississippi are classified as wildcats or semi-wildcats, which average a higher drilling cost than development wells. So far one-third of the total wells drilled have been wildcats.

An extensive drilling program that kept a good number of rigs busy in the state would bring costs down and figures for the last few years indicate this won't be too far in the future.

Production

Mississippi fields in general have water drive, are low in reservoir pressure and are sensitive to withdrawal. This means a high percentage of deep pumping or lift units (about 65 per cent of all producing wells) and large quantities of water produced with the oil and gas. (Cum. production, January 1, 1949—108,059,085 bbl water, 208,063,285 bbl oil, and 290,470,222,000 cu ft gas). Another problem for the state is handling low gravity crude oil, which comprises a substantial portion of total output.

Fields have been developed conservatively and efficiently. First the war and later scarcity of materials limited oil fields to 40-acre spacing. Heavy faulting and presence of grabens between faults, however, have led to an unusual number of dry holes within a field's boundaries.

Operators have been quite receptive to salt water disposal systems without being forced into the method by legal stipulation. Gulf Refining has put in an efficient disposal system at Baxterville. Three salt water disposal wells are in the Camerina lime formation at 2300-600 ft. Oil production is around 9000 ft.

Nine of Mississippi's oil fields produce 100,000 bbl or more a month. The oldest field in the state, Tinsley, in its 10th anniversary year, is producing almost a half million barrels of light crude oil a month, along with twice that much water. Tinsley's ultimate production is estimated at about 200,000,000 bbl. Part of the output goes to the Southland refinery near Yazoo City, and the remainder is piped in a Sohio line to a Mississippi River terminal.

For most of Mississippi's fields, history is in the making and because of their careful development and efficient methods, Mississippi fields will make production history that the state and the oil industry can be proud of.

Refining

The first full-fledged refinery in Mississippi was built in 1941 near Tinsley field by Paluxy Asphalt Company. The plant included skimming, cracking, and asphalt operations. The only other refinery was a small skimming plant at Vicksburg owned by E. C. Johnson and later purchased by Sohio and closed down in 1943. The late Rogers Lacy built a small skimming plant and asphalt operation at Sandersville near the Heidelberg field after this field was brought in. The unit had an actual capacity of about 1500 bbl per day.

The Southland group, now the only refiners in the state, has acquired both the Paluxy Asphalt plant near Yazoo City and the Sandersville plant. The Yazoo unit, originally 2500 bbl capacity, was enlarged to a point where the capacity is now 4000 bbl. A new light end recovery plant and catalytic polymerization are being added that will produce more high octane gasoline. The plant at Sandersville was recently re-built and enlarged to bring its capacity to 5000 bbl.

Products of the Southland Company are marketed principally in the South and asphalt products are sold not only to the Southern states, but are exported to a number of foreign countries. Exports move to South America, Europe, and some to Africa and Asia. A considerable amount of asphalt products goes to the Middle West for road-building purposes.

Hunt Oil Company at Tuscaloosa, Alabama, just across the Mississippi line, has a small plant that uses some heavy crude oil from Langsdale field.

The principal user of Mississippi crude oils is the giant Esso Standard refinery at Baton Rouge. This oil is transported by Interstate Oil Pipe Line Company and purchased by the Esso Standard Oil Company. Sohio is another large purchaser of Mississippi crudes.

To some extent Mississippi has the advantages of local refining and also the benefit of wider markets available through the large nearby plants. The advancement of pipe line construction may keep Mississippi from ever having large refining centers. The trend is toward more centralized refining with

transportation in the hands of the pipe line companies.

Pipe Lines

Before Tinsley field came in there were a few local gas pipe lines. In the 10 years since, the state has become criss-crossed with gathering lines, gas lines, crude oil lines, products lines, and lines that just use a right-of-way to pass through the state.

The pipe line industry is still building them. Construction of the longest natural gas line was begun at Laurel, Mississippi, last May. The Transcontinental line will go from Texas to New York. Also underway is construction of a United Gas pipe line from Baxterville to Mobile, Alabama, to augment gas supplies in that area.

The Texas Gas Transmission Corporation, Tennessee Gas Transmission, and Southern Natural gas each have big lines crossing the state. The long Plantation Products line goes from the Esso refinery in Baton Rouge across the state to Greensboro, North Carolina.

Largest network of gas pipe lines within the state are those of Southern Natural Gas Company and United Gas Pipe Line, which service many Mississippi cities. Interstate Oil Pipe Line Company and Sohio Southern Pipe Line Company have most of the crude oil lines.

The good servicing by pipe lines, river oil barges on the Mississippi River, railroad terminals and tank cars, and oil trucks has made possible rapid development of Mississippi. There was never any long delay for outlets from any producing field, and gathering and distribution is well and easily handled today.

Dynamics of Petroleum

Mississippi is a good pilot plant to test the benefits of petroleum to the citizens of a political unit. The effects of oil discovery and development are here compressed within a short time—10 years*—and have extended into nearly every part of the state and to some degree touched everyone of its citizens.

Mississippi needed a boost. It had never recovered fully from the Civil War when it was left with more freed slaves than white citizens, devastated land, and burned cities. General Sherman burned Jackson, the capital, and Vicksburg crumbled under the famous seige by General Grant's Army and the Union Navy. The tragedies of a postwar carpetbagger government squeezed out hopes of competent reconstruction. For years Mississippi bounced on or close to the bottom of all those high toned lists of economical and educational ratings.†

Lumber was sold, the Piney Woods was denuded, and no effort was made to reforest the area; agriculture rode up and down on the cash (and credit) cotton crop.

The last 10 years have seen a transformation in business and industry if not in the quiet culture of an old and lovely state. Oil has been a decisive factor in this vastly improved economic picture. It helped put cash money in the pockets of those who sold options and sold or held leases and royalties and of some 4000 wage earners in the industry. It provided the cheap fuel that encouraged many prosperous new industries to move to the state, and increased the efficiency of those already there. Severance taxes from oil and gas produced in the state have been a help in putting the state government on an efficient operating basis, and provides part of the millions of dollars being expended for modern school buildings and trained teaching staffs to improve the educational status of the state. After state sales taxes and state income taxes, petroleum taxes make the largest single contribution to state treasury.

The greatest publicity Mississippi has received in recent years has concerned the BAWI—Balance Agriculture With Industry—a plan whereby industries are subsidized by communities that vote bonds for that purpose. Petroleum development has been a large influence in the success of this original and progressive project, set up by former Governor Hugh White.

Jackson is headquarters of a good portion of the oil industry. Called Crossroads of the South because of its good air, railroad, and bus connections, the city has doubled in population in the 10 years since oil was discovered and has about 125,000 population. Old buildings have been modernized and tall shining new ones have gone up. The main thoroughfare, Capitol Street, would look like any other metropolitan district if one didn't suddenly come upon the impressive old governor's mansion with its wide lawns that shows Jackson still remains capital of the *Magnolia State*.

Besides Mississippi newspapers that carry drilling reports, Jackson has a weekly publication devoted entirely to oil and gas news, the Mississippi Oil Review, edited by Frank N. Henderson, a veteran of the southeast oil industry. Another weekly, Conservation News, includes petroleum in its coverage of the state's resources. C. L. Morgan supplies accurate overall oil reports in his Dixie Geological Service.

There is a congenial and understanding relationship between the state of Mississippi, its citizens and its officials, and the oil industry, which is made up of some 200 companies in the state. State oil and gas rules and regulations and tax laws have been based on those that have proved successful in other states.

Although Mississippi regulations point toward conservation of oil and gas resources they stop short of restrictions that would paralyze further development of those resources.

Conclusion

The more you go into the study of oil and gas in Mississippi the better the record looks. The background and surroundings are conducive to efficient and thorough development. After the first flush of excitement and virtual random drilling in the early days when Tinsley came in, the industry has used the hard-won knowledge of 90 years experience on this new oil state. The state itself has profited by the experience of older oil states in arriving at a realistic attitude toward the oil industry.

It is still not easy to find an oil field in Mississippi, but the Sherlocks of this industry are bent upon clues that will inevitably make it easier. Subsurface work continues* and new data is coordinated with the old. Core tests and electric logs of an ever-increasing range of exploratory drilling are compiling a history that will in time read the secrets of the deep structures of Piney Woods, the lower Mississippi River Basin and the Coastal Plains.

Drilling and production problems in Mississippi are not difficult with the heavy new rigs for deep drilling and the modern pumping equipment that permits economic pumping of deep reservoirs. Gathering and distribution is facilitated by water transportation on the Mississippi river and by the fact that the pipe lines are easily laid over most of the state.

At present production is suffering a temporary setback due mainly to the drop in demand, but Mississippi is well set for an increase when it comes.

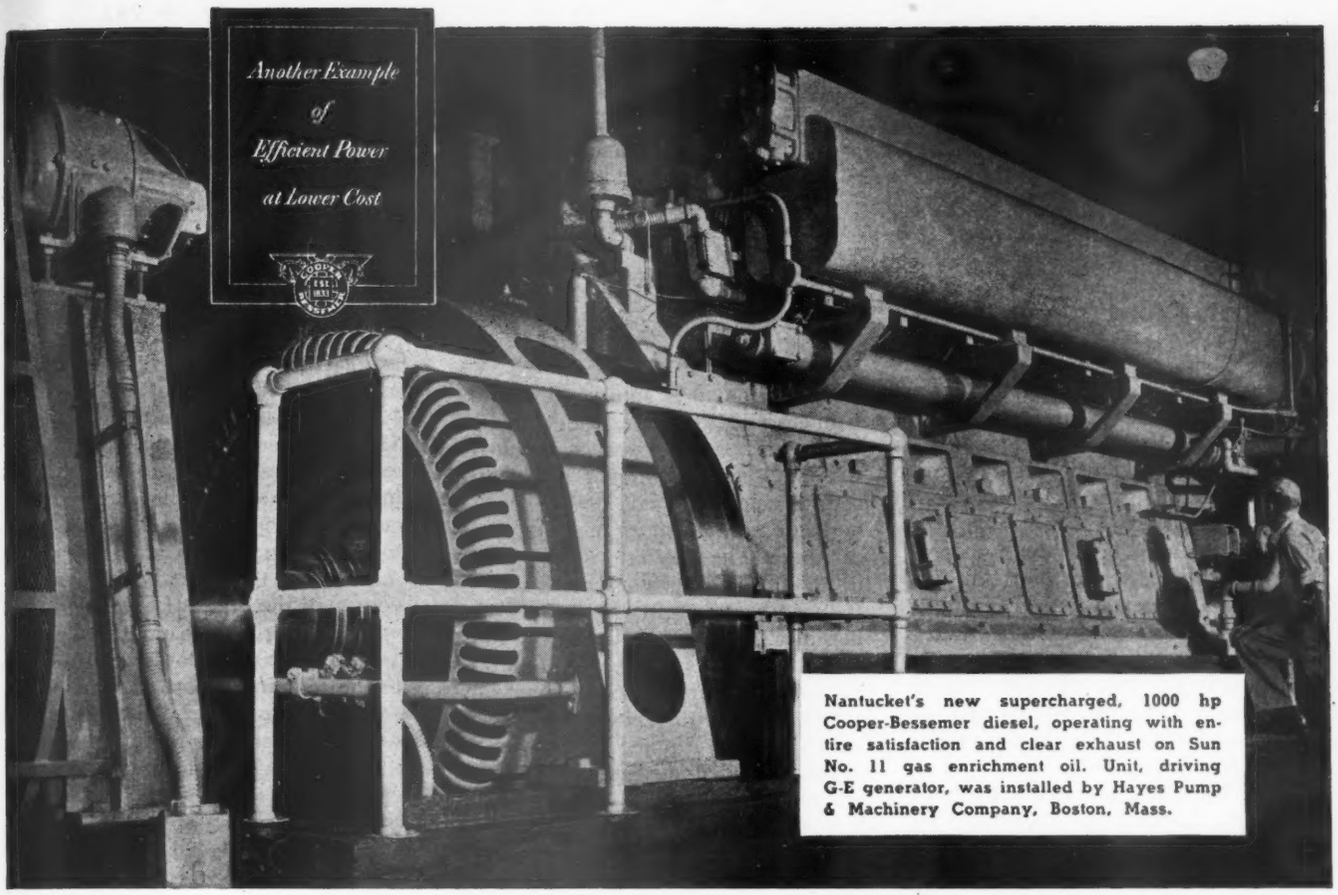
Mississippi may be an oil mystery—and in some ways it is—but a little puzzle here and there hasn't kept it from being pretty fast on its feet. Nobody can talk about the U. S. oil industry today without putting Mississippi on the front line, after only 10 years of being an oil-producing state. The next decade has every indication of greater development for oil in Mississippi.

* * *

*This does not include Amory and Jackson gas fields but their influence was limited.

†Said to be the 48th state in per capita income; 44th education, 1939.

*Shell Oil Company has spent two years, for instance, on the Jackson uplift and has been drilling a series of deep stratographic tests. Information will be released six months after the last test.



Nantucket's new supercharged, 1000 hp Cooper-Bessemer diesel, operating with entire satisfaction and clear exhaust on Sun No. 11 gas enrichment oil. Unit, driving G-E generator, was installed by Hayes Pump & Machinery Company, Boston, Mass.

Nantucket's New Diesel Burns Heavy Fuel

SAVES $11,950 A YEAR!

NANTUCKET Gas & Electric Company urgently needed additional power capacity. Their aging steam turbine plant was hardly adequate. After carefully weighing all factors, a supercharged Cooper-Bessemer diesel was picked for the job!

For one thing, due to existing fuel storage facilities and the island's transportation problems, it would be a tremendous advantage to fuel the diesel with the same, low-cost heavy oil burned in the turbine boiler and used as an enriching agent in gas-making. Cooper-Bessemers had already demonstrated their ability to operate efficiently, reliably on Bunker C and other heavy oils.

Secondly, extremely close speed regulation was essential. The new unit was to be paralleled with the turbine generators and was to power an aircraft radio beam requiring exceptional cyclic control. Here again Cooper-Bessemers offered proved performance.

These and other problems in this unusual installation, *including the elimination of smoke*, despite the heavy fuel, were overcome right from the start. Consequently, the new engine went into service at once. And, by burning heavy fuel instead of regular diesel fuel, it is estimated that the new Cooper-Bessemer will save $11,950 a year at present fuel rates.

Whether your power need is ordinary or unusual, if you want to know how you can cut your power costs year in, year out, check with Cooper-Bessemer.

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Mississippi Oil and Gas Taxes

W. HALL WALLACE

DISCOVERY of oil in commercial quantity in Mississippi is of comparatively recent date, the first producing well, Union Producing Company's Woodruff No. 1 in Tinsley field, Yazoo County, having been completed September 5, 1939. This state, which now ranks ninth in daily production, was the twenty-third in point of time, in which oil has been found. Therefore, with the experiences of 22 other states for reference, taxation relating to oil and natural gas was adopted to harmonize with the nature of the new industry; and some of the measures are an advance in this field.

Inquiries often are made by concerns that contemplate operations in Mississippi, as to what taxes they will be subject to and how these taxes are administered. Some taxes apply to all concerns and persons doing business in the State and some to only specific industries or activities. The principal ones, of both kinds, that may be encountered by the oil and gas industry are as follows:

Entrance Fees

For recording the charter of a corporation the fee is $20 for the first $5000 of capital stock and $2 for each additional $1000 or part thereof, up to a maximum of $500, payable in advance to the Secretary of State. In the case of no-par stock the maximum fee is $500, which will be held 30 days; and if value is declared during the 30-day period, then rates based on total declared value will apply. Fees for domestication of foreign corporations are the same as foregoing, but domestication is not required if the corporation is willing to waive certain benefits.

Corporation Franchise Tax

For all corporations operating in the State an annual franchise tax is due at the rate of $1.50 per $1000 or fraction thereof, of the capital used, invested, or employed in the State. For corporations operating both within and without the State, the tax is determined by the ratio of property owned and gross receipts in Mississippi to all property and total receipts. Minimum tax is $10. This tax is payabe to the Chairman of the State Tax Commission.

Unemployment Compensation Tax

Any empoyer is subject to this tax, if in each of 20 weeks, whether or not such weeks are or were consecutive, within either the current or the preceding calendar year, he has or has had in employment eight or more individuals. The base rate is 2.7 per cent of the gross payroll, which may be reduced because of the employer's experience and the reserves in the fund, to as little as 0.9 per cent. Three thousand dollars per year is the maximum salary of any one employee against which the tax applies. No part of the tax may be deducted from salaries or wages of employees. Certain employments, such as agricultural and domestic help, are not subject to the tax. Payments are made to the Mississippi Employment Security Commission. This law, Chapter 412 of Mississippi Laws of 1948, should be studied carefully by all employers.

Contractor's Privilege Tax

Any person or concern before bidding upon a contract the price of which exceeds $3000, must obtain from the State Tax Commission a license as a contractor by payment of $25. This tax is an annual tax and the license entitles the holder to submit bids at any place in the State during 12 months from the date thereof. If the bid is made outside of the State this tax is not applicable. Before the execution of contracts over $3000 an additional license at the rate of 50 cents per $1000 or fractional part thereof of estimated cost, must be obtained; and when the contract is completed the same rate applies to actual costs in excess of the estimate. In addition to these privilege taxes, the contractor also is liable for sales tax on the amount of the contract. (See paragraph 2 of section on "Sales Tax" herewith).

Drilling Rig Privilege Tax

Drilling rigs have been exempted from ad valorem tax, but the owner pays an annual privilege tax on each rig used in the State. The rates per 1000 ft of capacity of drilling depth are as follows: 7500 ft or less, $75; more than 7500 ft and not exceeding 12,500 ft, $130; more than 12,500 ft, $175. A license must be procured for each rig (described in detail), by payment of tax, from the sheriff of the county where the rig is first used, prior to use of rig; and is good for the remainder of the calendar year in any county of the State. If a license is first obtained during any month other than January, the payment is in proportion to the remaining part of the calendar year to the full year. This license must be renewed and tax paid in the county in which the rig is located, the first of each year, as long as the rig is in the State. The license applies only to the complete rig described, and not to spare parts and equipment, which are subject to ad valorem tax.

Sales Tax

Mississippi has a sales tax, which the law designates a tax upon the privilege of engaging in certain businesses in the State. The rate is 2 per cent upon the gross income from sales of tangible property to the consumer, and upon the gross income from many services listed in the law. There are some exemptions, however, such as on agricultural products sold by the producer at place of production, sales by non-profit organizations, sales to governmental agencies, and also on a few specified items. Oil and natural gas sold by the producer are not subject to the sales tax, but to a severance tax. The law requires the tax to be paid by the vendor but to be added to the sales price of personal property.

In the case of contracts amounting to $3000 or more, the tax is 1 per cent of the contract price or compensation received, and is paid only by the prime contractor. When the price or compensation amounts to $10,000 or more, the contractor must execute a bond to the State Tax Commission before the work is commenced, to guarantee that accrued taxes will be paid when due. If a bond that includes security for the sales tax, however, has been posted with the Chairman of the State Tax Commission, or with some other State officer and is acceptable to the Tax Commission, the foregoing separate bond need not be made. The sales tax

EXCLUSIVE

is in addition to the privilege taxes mentioned elsewhere.

Purchases made by a contractor who is subject to the 1 per cent sales tax, of materials that are to become a component part of any structure or improvement erected or constructed or repaired, are taxable at the wholesale rate of ⅛ of 1 per cent in lieu of the 2 per cent rate. But the tax is 2 per cent on all fuel, materials, supplies, equipment, and other items used in performance of the contract, that do not become a component part of the finished improvement. However, all materials and other items, even though they become part of the improvement, purchased by the party for whom the contract is performed, are taxable at 2 per cent. For example, if well casing were furnished by the drilling contractor as part of the contract, the tax paid the State would be 1⅛ per cent, but if purchased by the well owner the tax would be 2 per cent.

A tax at the rate of 2 per cent of gross income is levied upon every person or concern in the business of operating a pipe line for transporting for compensation from one point to another in the State, oil or natural gas. If, however, oil or gas is moved through a pipe line between Mississippi and another state, such movement is defined by the Mississippi law as business conducted in interstate commerce, which the State is prohibited from taxing, under the Constitution of the United States. In a recent case (Interstate Oil Pipe Line Company v. Stone) decided by the Mississippi Supreme Court June 14, 1948, and affirmed by the U. S. Supreme Court June 20, 1949, it was held that the pipe line transportation of oil gathered by the company from lease tanks, transported to a loading rack in Mississippi, and there loaded into railroad tank cars for shipment outside the State, was subject to the tax because the pipe line operation was solely within the State. even though it was known when the oil was gathered that it was destined for a point in another state.

Use Tax

This tax is for the privilege of use, storage, or consumption, within Mississippi of tangible property purchased at retail or produced or manufactured for commercial use, or rented or leased, and benefits from services listed in the sales tax law. The use tax is designed to protect merchants, dealers, manufacturers, and persons rendering services in Mississippi, who meet the requirements of the sales tax laws, against the competition of importations of goods and services into the State without payment of the sales tax. The rates are the same as those of the sales tax, and the law is administered by the State Tax Commission.

Exemptions from the use tax are for property and services already subject to the sales tax; property and services specifically exempt from the sales tax; property used in the furtherance of interstate transportation or interstate commerce; property brought into the State by an individual non-resident thereof for his use, while temporarily within the State, unless such property is used in conducting a non-transitory business activity within the State; and property or value of services that has been taxed in any other state at equal or greater rates. If the rate of tax paid in another state has been less than in Mississippi, the difference between the two rates is to be paid to Mississippi.

In the case of Interstate Oil Pipe Line Company v. Stone, heretofore mentioned in connection with the sales tax, where it was held that the gross revenue from oil transported was subject to the sales tax, it also was held that the pipe of which the line was constructed was exempt from the use tax because the property was used in the furtherance of interstate transportation or interstate commerce.

The Author

William Hall Wallace studied engineering at the University of Wisconsin and Johns Hopkins University. He is a registered professional engineer in the states of Mississippi and Wisconsin. His early engineering experience was on railroad location and construction with the Baltimore and Ohio Railroad Company and the Western Maryland Railway Company, also with the Bolivia Railway Company in the Andes Mountains of South America. He spent one year with the U. S. Geological Survey and two and one-half years in the Department of Engineering and Construction of the Panama Canal. He was resident engineer for the Caribbean Petroleum Company at Maracaibo, Venezuela, when that company brought in the first oil well in Venezuela at Mene Grande in 1914.

After returning to the United States he was assistant engineer with the Crown Cork and Seal Company and construction engineer with Davison Chemical Company at Baltimore. During the latter part of World War I he was first lieutenant of Engineers, U. S. Army. Following the war he spent one year as assistant engineer in the Oil and Gas Section of the U. S. Internal Revenue Bureau, and then two years ds manager of the Dallas office of Johnson, Huntley and Somers, geologists and engineers. For 10 years he was valuation engineer for The American Appraisal Company, engaged in the valuation of oil and gas producing, transporting, refining and marketing properties, as well as public service and industrial concerns. In November, 1932, he was appointed to his present position as valuation engineer for the Mississippi State Tax Commission, and upon the passage of the oil and gas severance tax acts, was made also chief of the Oil and Gas Severance Tax Division.

Income Tax

This tax applies to corporations, and to individuals having gross income of $5000 or more annually or net income in excess of statutory exemptions. The rates on total net income over specified exemptions are 1 per cent on the first $4000, 2 per cent on the next $3000, 3 per cent on the next $3000, 4 per cent on the next $5000, 5 per cent on the next $10,000, and 6 per cent on all over $25,000. When gross income is derived from sources partly within and without Mississippi, only income allocable to the State is taxed and exemption is prorated on the basis of gross income in the State to total gross income. However, income from production is not subject to proration and that from properties in Mississippi is considered income in the State. Corporations, other than those entirely exempt, are not allowed exemptions. Income tax is payable to the Chairman of the State Tax Commission.

Deductions from gross income are permitted so that the tax will be only on net income and not on capital consumed. The original investment represented by actual cost, plus costs of additions and improvements not charged to expense, is the basis for computing these deductions. The aggregate of deduction is limited to the cost of the property less its value at the end of its useful life.

The capital sum to be replaced by depreciation is the difference between the investment and its salvage value, and is to be charged off over the useful life of the property, either in equal annual installments or in accordance with any other recognized trade practice, such as apportionment over units of production. For oil and gas properties the investment against which depletion may be claimed is the amount paid for the lease, or in the case of fee properties, the portion of the cost initially assigned to oil and gas reserves, plus development costs such as drilling, that have not been charged to expense. Depletion is to be computed for each individual producing tract or lease, and a choice of one of the following two methods is permitted: annually in proportion to exhaustion of estimated reserves, or at the rate of 15 per cent of gross income per year but not in excess of 30 per cent of the net income (computed without allowance for depletion), until the investment is retired.

Mineral Documentary Tax

A Mississippi statute (Chapter 409 of Laws of 1946) that is unique in taxation of oil and gas properties, and has received favorable comment from

officials of other states, as well as the oil and gas industry, exempts non-producing leases, mineral rights and royalties from ad valorem taxation and imposes a tax upon them at the time instruments transferring them are recorded. This tax is paid upon the filing and recording of every oil and gas lease upon non-producing properties and assignment or extension thereof, also upon every deed, instrument, transfer or evidence of sale whereby there is conveyed to a purchaser, or reserved to a grantor, separately and apart from the surface, any interest in, or right to receive royalty from any non-producing oil, gas or other minerals in, on or under or that may be produced from lands within the State. Leases and mineral rights created before June 10, 1946, remain liable for ad valorem tax until application for exemption is filed and the documentary tax is paid.

The rate of tax is 3 cents per mineral or royalty acre on instruments whose primary term does not exceed 10 years, 6 cents if the primary term is longer than 10 years and does not exceed 20 years, and 8 cents if the primary term is greater than 20 years. The tax is due and payable to the chancery clerk of the county where the property is situated, by the purchase and affixing of documentary tax stamps to the instrument recorded.

The stamps are supplied the chancery clerks by the State Auditor; and all amounts from the sale of stamps go to the county, one-half to the county common fund and one-half to the county school fund. The face value of all stamps provided the counties from June 10, 1946, the date the law became effective, to June 1, 1949, has amounted to $1,124,590; and as only small quantities of stamps are kept on hand in the counties, this figure is not much greater than the amount of tax collected.

Ad Valorem Tax

Some operations of the petroleum industry have been freed to a large extent from ad valorem taxation. Non-producing oil and gas leases, mineral rights and royalties created or assigned on or after June 10, 1946, and those in existence at that date, on which the documentary mineral tax has been paid, have been exempted from ad valorem taxes levied on or after January 1, 1947, by Chapter 409 of Mississippi Laws of 1946. All oil and gas produced or under the ground on producing properties and all producing equipment owned by the producer, and all leases in production, including mineral rights in producing properties, are exempted by Chapter 134 of Laws of 1944 and Chapter 447 of Laws of 1948. But this exemption does not apply to other property such as surface of lands, inactive equipment, materials and supplies and automobiles, nor to gathering systems and trunk pipe lines with their pumps and other appurtenances. Drilling rigs, but not spare equipment and other items in connection therewith, are exempted by Chapter 442 of Laws of 1948.

Certain new enterprises may be exempted for a period of 5 years from county ad valorem, but not State ad valorem taxes, by action of the Board of Supervisors of the county in which the property is to be located. The time of such exemption, for domestic corporations commences from the date of the charter, and for foreign corporations, from the date of such corporation's qualification to do business in Mississippi. However it is not mandatory that the counties grant these exemptions. The law lists many types of properties that may be exempted, and among these are natural gas and crude oil pipe lines, pumping and compressor plants, distribution systems, natural gasoline plants, petroleum refineries, and plants for recycling, pressure maintenance, and hydrocarbon extraction, with their pipe lines, pumps and other property. For the foregoing exemptions reference may be made to Section 9703 of Mississippi Code of 1942 as amended in 1944 and 1946, and Chapter 439 of Laws of 1948.

All property in the State on January 1st of each year (unless specifically exempt) is subject to assessment for ad valorem taxes. Personal property is assessed each year, and real property every two years, in even numbered years. Common carriers such as railroads and pipe lines, together with public service properties located in more than one county, are assessed annually by the State Tax Commission. Other properties are assessed by the county tax assessors, and if in municipalities, also are assessed by the city assessors for municipal taxes. The Tax Commission has no authority with respect to individual assessments of general property assessed by the counties, nor with any assessments made by cities, but is required to equalize by classes of property only, the assessments between the counties.

The State ad valorem rate is fixed by law at 4 mills on the dollar, but, under certain conditions, may be reduced to 2 mills by proclamation of the Governor. Since the vear 1941 the rate has been kept at 2 mills. Rates in the counties and in different tax districts of the same county, vary greatly. One large company that has properties in 43 counties and 130 municipalities in the western part of the State, reports for the year 1948, the average tax rate it paid on properties outside municipalities was 39.24 mills, and on properties inside municipalities 58.86 mills. Total ad valorem taxes received by the General Fund of the State, at the rate of 2 mills, for the fiscal year July 1, 1947-June 30, 1948, amounted to $964,960.79, and were 1.88 per cent of General Fund receipts.

State, county, levee, road, and consolidated school district taxes are payable to the sheriff of the county in which the property is located. Municipal and separate school district taxes are payable to the municipal tax collector. No ad valorem taxes are collected by the State Tax Commission.

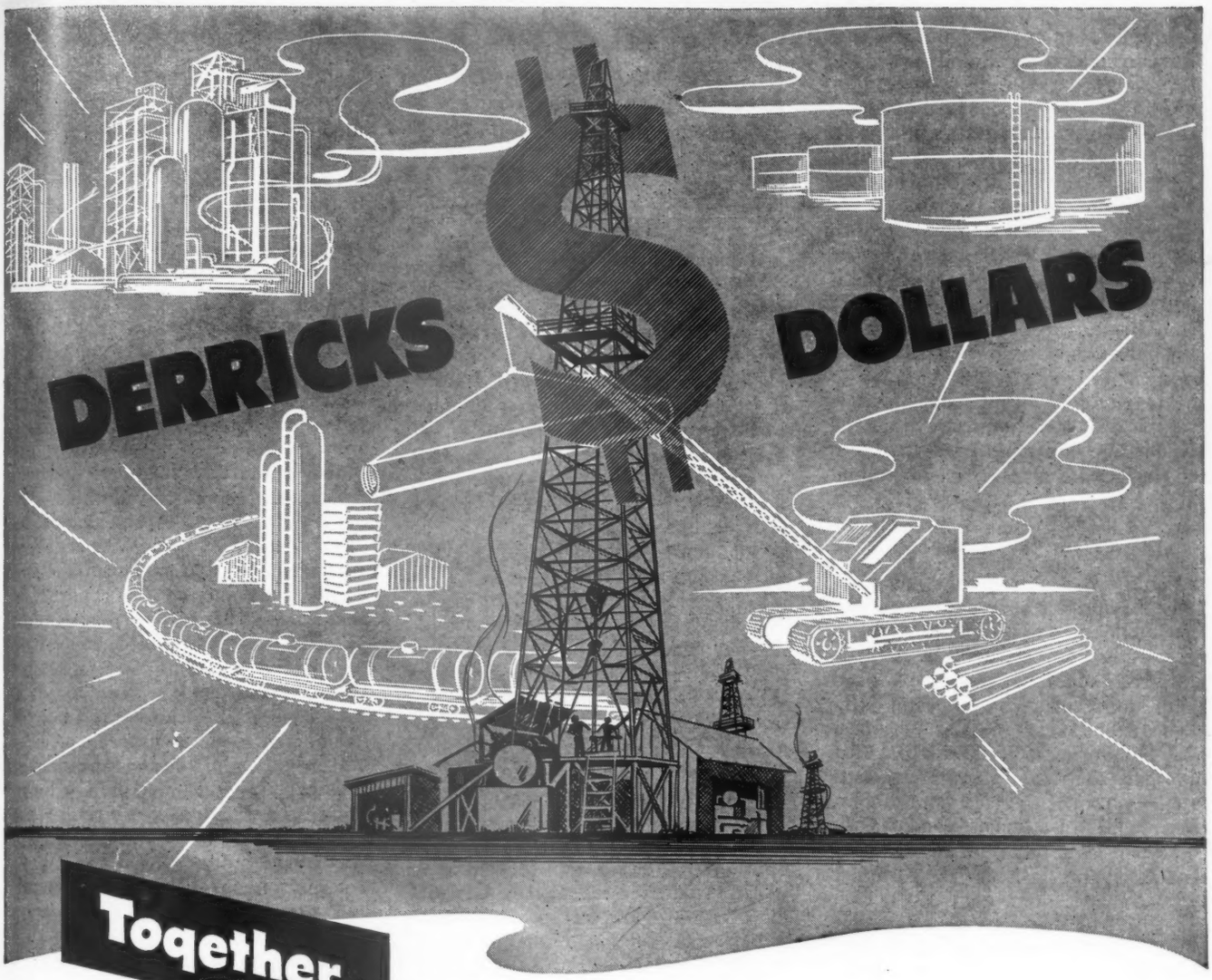
Gasoline Tax

Any person or concern engaged in the business as distributor, or who acts as distributor, pays for the privilege of engaging in such business or acting as such distributor an excise tax as follows: 6 cents per gallon on all gasoline stored, sold, distributed, manufactured, refined, distilled, blended, or compounded in this State, or received in this State for any purposes; ½ cent per gallon on all oils (defined as any petroleum fuel or product other than gasoline, which is usable as fuel in an internal combustion engine) stored, sold, or distributed, or received in this State for sale, storage, distribution, or use. However, if any of such oils is used as fuel for motor vehicles on the highways, the tax is 7 cents per gallon. The tax on liquefied petroleum gas is ⅛ of 1 cent per gallon except when it is used as fuel in internal combustion engines, in which case the tax is the same as on gasoline. Refiners and processors pay tax on the same basis as distributors, except the tax is only on products withdrawn from storage. The tax may be passed on to the ultimate consumer.

Bunker or crude oils used for generating heat in a fire box or furnace, are exempt, as are also lubricating oils. Any person, firm, or corporation that purchases and uses gasoline for agricultural, maritime, industrial, or domestic purposes and which is not used in operating motor vehicles upon the public roads, streets or highways, is entitled to a refund at the rate per gallon of 1 cent less than the tax paid. This law is complicated and should be studied carefully by interested parties.

Oil and Gas Conservation Taxes

A permit to drill a well in search of oil or gas must be secured from the State Oil and Gas Board, and, for this a fee of $25 is paid. Also, to pay the costs of administration of the oil and



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gas conservation laws, there is levied a charge not to exceed 2 mills on each barrel of oil produced and saved, and not to exceed 1/10 mill on each 1000 cu ft of gas produced, saved and sold. These payments are to be made to the State Oil and Gas Board, on or before the 25th of the month following that in which the production occurs. When oil or gas is sold under contract requiring payment to the respective persons owning interests therein, the charge is paid by the purchaser and deducted from his payments to said persons. When the sale is without such contract, payment is made by the operator of the well and deducted from amounts due the respective interests. Since the law became effective, April 10, 1948, the charges have been at the maximum rates.

Oil and Gas Severance Taxes

For the fiscal year ended June 30, 1949 oil and gas severance taxes collected amounted to $6,683,261.99, and ranked fourth in taxes collected by the State Tax Commission, being exceeded by the tobacco tax by less than $18,000. Of total Tax Commission collections amounting to $57,271,870.12 for the year, sales and use taxes constituted 44.42 per cent; income, franchise, and installment loan taxes, 24.56 per cent; tobacco tax 11.70 per cent; oil and gas severance taxes, 11.67 per cent; and other taxes, 7.65 per cent. The average cost of collecting all the foregoing was $1.41 per hundred dollars collected, one of the lowest costs, if not the lowest, for any state in the country. But the cost of collecting the oil and gas severance was only 21 cents per hundred dollars.

The oil severance tax, which became effective March 1, 1944, is at the rate of 6 cents per barrel or 6 per cent of the value of the oil produced, whichever is greater. The gas severance tax, which became effective July 1, 1948, is at the rate of 3 mills per 1000 cu ft, measured at 15.025 psia, or 6 per cent of the value of gas sold or used, whichever is greater. The tax is not levied upon gas injected into the earth for cycling, repressuring, or lifting oil, nor upon gas lawfully vented or flared in connection with the production of oil, nor upon gas condensed into liquids on which the oil severance tax is paid. But excluded from this exemption is gas sold for injection into the earth.

The acts levy annual privilege taxes upon every person engaging or continuing within the State in the business of producing, or severing oil and gas from the soil or water, and apply to both well operators and those receiving oil or gas or payments from the sale thereof, as royalties, all of whom

See Page E-59 for table giving full information about Mississippi oil and gas fields, including average price paid for oil in various fields.

are defined by the law as producers. The person in charge of production operations is liable for payment of the tax on all oil produced and on all gas sold or used, except that specifically exempted, and is authorized and required to deduct from any amounts due to producers of such oil or gas at the time of severance, the proportionate amount of the tax before making payments to such producers. The laws provide, however, that when oil or gas is sold under contracts requiring the purchaser to pay all owners of such oil or gas direct, the tax shall be deducted by the purchaser before making payments to each owner, and the purchaser shall account for the tax. When such payments are made by the purchaser, the producer or operator pays on only the oil or gas he uses or sells to someone who does not withhold and pay the tax.

These taxes are divided by the State Tax Commission between the General Fund of the State and the counties where production takes place. For oil, the division of the first $600,000 collected on production in a county during the calendar year, is ⅔ to the State and ⅓ to the county; on the next $600,000, 90 per cent to the State and 10 per cent to the county; and on all exceeding $1,200,000, 95 per cent to the State and 5 per cent to the county. For gas, the division of all amounts collected on production during the year, is ⅔ to the State and ⅓ to the county. If production occurs inside a municipality, part of the county's share (not to exceed ⅓) is paid by the county to the municipality.

The constitutionality of the oil severance tax act was tested in a suit brought by Gulf Refining Company, at the instance of royalty owners, for recovery of taxes paid, and the validity of the act was upheld by the Mississippi Supreme Court (Gulf Refining Company v. A. H. Stone, State Tax Commissioner, 197 Miss. 713; 21 So. 2nd. 19). The wording of the gas severance tax act closely follows that of the oil severance, and although it has not been questioned, if it were, there is reason to believe it also would be upheld.

At the time the oil severance tax became effective, a separate division for its administration was established by the Tax Commission; and when the severance tax was placed on gas, the administration of this was added, and the division now is designated the Oil and Gas Severance Tax Division. The chief valuation engineer of the Commission, because of his long experience in the petroleum industry, was also made chief of the new division. Consolidation of oil and gas taxes with the valuation work has had the effect of marked economies in the operation of both, due to the close relationship of many features.

The first undertaking was the design of forms on which the tax and supporting data were to be reported, as the forms used by other states did not fit the requirements of the Mississippi law. In designing the forms, particular attention was given to procuring data necessary for administration of the law, in the most efficient and economical manner, with the least possible work and inconvenience for the persons making the reports. An effort was made to limit, as much as possible, the information to be supplied, to what could be transcribed from existing records. The sizes of all forms are 11 in. deep by 17 in. wide, twice letter size, so they can be filled out on either standard or broad carriage typewriters, and kept in ordinary filing cabinets. Before printing, tentative designs were submitted to members of the industry for their suggestions on changes and improvements; and the final designs incorporated these suggestions insofar as practicable. For oil, two forms are used, an oil producers' monthly report (Form OST-1) and an oil purchasers' monthly report (Form OST-2). For gas, two forms are used, a gas operators' monthly report (Form GST-1) and a gas purchasers' monthly report (Form GST-2).

The reports from oil producers and gas operators are compared with the reports made by the purchasers, and with reports on pipe line runs and disposition of oil and gas that are made to the State Oil and Gas Board. All figures and computations are checked for accuracy, and if discrepancies are found, these are referred to the persons or concerns that have made the reports, so corrections can be made. Additional checks on production are obtained by gauging tank batteries at intervals, and by spot-checking records in producers' and purchasers' offices.

A card file is maintained for all field wells, and is kept current from weekly reports received from a geological and scout service, supplemented by data sent to the Oil and Gas Board. As soon as a well is completed a card is prepared showing the name and location of the well, the

TABLE 1. Oil severance tax data, March 1, 1944, through June 30, 1949.

Year	Barrels of oil produced	Value of oil produced	Barrels of oil sold	Tax Collected
1944 (10 months)	13,768,665	$ 14,122,840	13,583,637	$ 859,388.88
1945	19,000,067	19,290,062	18,875,780	1,202,602.77
1946	24,300,911	30,323,206	24,245,130	1,382,052.10
1947	35,182,849	61,973,190	35,089,706	3,689,431.26
1948	45,621,312	110,284,337	45,585,366	6,612,041.14
1949 (6 months)	19,593,597	48,795,742	19,581,189	2,929,484.88
Totals	157,467,401	$284,789,377	156,960,808	$17,125,001.03

TABLE 2. Natural gas severance tax data, July 1, 1948, through June 30, 1949.

Year	MCF gas produced (Including Recycled and exempt)	MCF gas sold and used (Taxable)	Value of gas sold and used	Tax collected
1948 (6 months)	46,366,969	28,746,813	$1,656,185	$103,323.42
1949 (6 months)	49,323,744	31,023,857	1,908,430	116,854.49
Totals	95,690,713	59,770,670	$3,564,615	$220,177.91

date of completion, and other pertinent information. New wells also are platted on field maps, which are kept up to date. Thus all producing wells are accounted for. With the foregoing information at hand, as soon as a well is brought in by someone who has not had occasion to report on other properties, a supply of forms is sent him, accompanied by a sample of a completed report and a guide describing how the reports should be prepared, together with a copy of the severance tax law. The same procedure is followed for new purchasers.

In the records of the division an account is set up for each oil-producing lease at the time the first report is received. This account is debited each month with the amount of tax that has accrued on the oil produced during the month, and is credited with the amounts of tax paid from all sources. Also, the quantities of oil produced, sold, and on hand at the beginning and end of the month, together with the value of production, are recorded. Usually there is a small debit balance carried forward at the end of the month; and this balance is equal to the tax that has accrued on the stock in lease tanks at the same time. The quantity on hand at the end of a month is considered to be the first oil run during the following month, and by this system collections are kept up to date as closely as possible. Gas accounts are kept in much the same manner, except there is no carry-over at the end of a month for gas above ground.

Data in summary form from the records of the oil and gas severance tax division are presented in Tables 1 and 2. Table 1 shows by calendar years the production, value, and sales of oil, and also the amount of tax collected. Table 2 shows the same for gas.

No difficulties have been encountered in the administration and collection of the oil and gas severance taxes, and it is believed that all taxes due have been accounted for, and no attempts have been made to escape the tax. The Commission has had the full cooperation of all producers and purchasers, and reports and remittances have been made on time, except in a few unavoidable instances. The greater equity of the severance tax as compared with the ad valorem tax on oil and gas producing properties is apparent, because proper valuation of producing properties for ad valorem assessment is an impossibility for the layman and even something of a problem for valuation specialists. The constant, and often rapid, changes in value of a producing property need closer attention than is practicable under the ad valorem system. On the other hand, the severance tax is adapted to these changing values, because it is collected in proportion to the value of the product at the time of production.

Additional Details Necessary

Within the limits of this article it has been impossible to include many important particulars of the tax laws mentioned. Therefore anyone who is interested in one of the taxes should contact the department that handles it, and procure a copy of the regulations and other essential information.

Mississippi State Tax Commission

The State Tax Commission consists of three members appointed for six-year overlapping terms, A. H. Stone, chairman, M. C. Young, ad valorem commissioner, and J. F. Frierson, excise commissioner. Mr. Stone, who was appointed chairman May 2, 1932, has served in that capacity continuously under five governors, and the present governor has announced he will reappoint Mr. Stone whose term expires in May of next year.

Since Mr. Stone first took office, the Commission has operated on a strictly non-political basis, in an efficient, businesslike manner and much to the benefit of the State. When the Legislature met in 1932, the cash balance in the General Fund of the State Treasury stood at $1,326.27. Today it stands at $27,278,741.81. In 1932, the total of the State's General Fund obligations amounted to $43,944,436.15, of which more than seven million dollars were in floating obligations in the form of unpaid appropriation balances and outstanding warrants against the Treasury, and the State had not been able to sell a bond in the open market for more than three years. Its credit was gone. Today the General Fund bonded debt stands at $10,799,500, supported by a State investment in U. S. Government bonds of $12,064,309.46, and the State's credit is as good as any in the Union.

Prior to May 2, 1932, the Tax Commission was charged with the collection of 7 taxes, and collections were running at slightly more than $2,000,000 a year. Operational costs of the Commission were as high as $13.20 per hundred dollars of revenue collected. Today the Commission administers 16 separate tax laws, and collections for the fiscal year ended June 30, 1949, amounted to $57,271,870.12. Collection costs were $1.41 per hundred dollars. Total collections by the Commission from May 1, 1932 to June 30, 1949, have been $393,839,221.64. The importance of the part played by the State Tax Commission is indicated by the fact that it is collecting approximately 90 per cent of the State's General Fund revenues.

The policy of the Commission has been stated by its Chairman, as follows: "The power to tax involves the power to destroy, but, contra, the administration of the tax may itself be made an instrument of service rather than an agency of destruction. And this is precisely what we have tried to make of this Commission, through the policy here set out, which has governed our administration of its affairs. We have tried to serve the taxpayers of the State upon a basis of equal and exact justice to all, regardless of the nature or magnitude of the particular operation, without prejudice on the one hand or favoritism on the other. The basis of our operations is cooperation rather than coercion. We give the taxpayer the benefit of the doubt. We believe that the confidence and the cooperative good-will of the taxpaying public are just as valuable assets to the State of Mississippi, and to this Commission in its efforts to serve the State, as customer good-will is to a commercial or to an industrial enterprise."

* * *

P 981.111.

Mississippi

Oil and Gas Laws, Rules, and Regulations

H. M. MORSE

ANY discussion of the laws of Mississippi, will of necessity, carry with it a history, or background, of drilling activities, before the first conservation law was passed in the State.

The records show that the first well drilled in Mississippi, for oil or gas, was drilled east of Enterprise, Clarke County, in the spring of 1903, to a total depth of 1842 ft.

In October, 1926, a group of citizens in Monroe County, near Amory, Mississippi, pooled their resources and drilled a well, known as the Carter No. 1. This was a discovery well of the Amory gas field and subsequently it was found that this gas field had small reserves, and very little volume.

The Jackson gas field was discovered in February 1930. The discovery well was Mayes No. 1 well of the Jackson Oil and Gas Company.

Two years after the discovery of the Jackson gas field, the Mississippi Legislature, at the regular Session of 1932, created the State Oil and Gas Board, the measure being signed by the Governor on May 18, 1932. By provision of the Statute, the Board consisted of the Governor, the Attorney General, the Land Commissioner, and the State Oil and Gas Supervisor. The State Oil and Gas Supervisor was to be appointed by the Governor, and confirmed by the Senate. The first appointment of the Supervisor was made on June 10, 1932. The State Oil and Gas Supervisor was by Statute made the executive officer of the Board.

After the appointment of the Supervisor, his first duty was to make a collection of all known data about wells that had been drilled up until this time, also, to keep abreast of any developments taking place after his appointment. The Supervisor found his duties to be numerous and various. The statute made him its enforcement agent; however, on a number of administrative matters, the statute was silent. Drilling operations were carried on with a minimum of friction between the Supervisor and the agent.

The Supervisor made an effort to enforce regulations as to withdrawals of gas from individual wells, so as to prevent discrimination and assure fair treatment to all well owners alike. On the advice of the Attorney General, the Supervisor's order provided for gas proration in the Jackson gas field, and it was not carried into court. The pipe line companies protested the order, and as there appeared to be grave doubt as to whether the order would stand up in court, the matter was dropped for the time being. The State Oil and Gas Board, realizing the increasing importance of the conservation of our natural gas resources, recommended to the Legislature that the statute should be strengthened.

At the regular 1936 Session of the Legislature, Senate Bill No. 490 was passed by the Senate and the House and approved by the Governor on March 26. This bill provided for the proration of producing gas fields to be based equally on acreage and open-flow capacity. On May 16, 1936, the State Oil and Gas Board issued a special order, as required by this law, fixing the allowable production of gas from the Jackson gas field. This order was protested by some of the companies operating in the field and a hearing was held by the Board. The Board declined the protest and the companies protesting carried the matter to the United States Circuit Court of Appeals in New Orleans, Louisiana. An injunction was granted against the State's enforcing this proration order.

The State of Texas, using a similar law, had appealed a case from the same court in New Orleans to the Supreme Court of the United States. The United States Supreme Court ruled against the State of Texas. With this condition confronting them, the Board did not consider it advisable or practical to appeal their case as the Texas and Mississippi cases were so nearly parallel that the same decision undoubtedly would be rendered in both instances.

The day before the Supervisor was appointed, a gas well caught fire. This cost the lives of four men, and threatened the depletion of the gas field. It was finally brought under control, with a waste of gas of approximately 250,000,000 cu ft, and an expenditure of approximately $15,000. The Supervisor, exercising a rather doubtful authority conferred upon him by resolution of the Board, took nominal charge of the situation, but having no funds at his command for such emergencies, was forced to leave the direction of the fire fighting operation largely in the hands of the pipe line companies. The Legislature was called upon to pay a portion of the cost.

A fee of $25 was to be collected on wells drilled in a proven field. On wildcat wells, however, no fees were required. This fee charged, was to be used in connection with the support of the State Oil and Gas Board. The Legislature provided a sum of $10,000 for the biennial. This amount, in addition to the fees, was only enough for the normal operation of the Board. This practice was carried on until a new Board was created in May 1948. The Legislature did increase the biennial support sum, however, and the fee of $25 was amended to include wells drilled for any purpose, other than a water well.

By 1948, it had become apparent that the Board as constituted. the

THE AUTHOR

H. M. "Don" Morse of Jackson, Supervisor and Ex-Officio Secretary to the Mississippi Oil and Gas Board, was born in Mississippi. He attended and received the B.S. degree in geology from the University of Oklahoma. He later did graduate work in geology at Texas University.

Upon completion of his work at the University he returned to Mississippi, serving as Assistant State Geologist, Acting State Geologist, and Professor of Geology at the University of Mississippi. In 1938 he became Director of the Mississippi State Oil and Gas Board and when the new Oil and Gas Law of 1948 was passed he was reappointed to his present position.

Two years ago Morse served as State Commander of the American Legion and he is quite active in various civic clubs. He is a member of the API, IPAA, and does committee work on the Interstate Oil Compact Commission.

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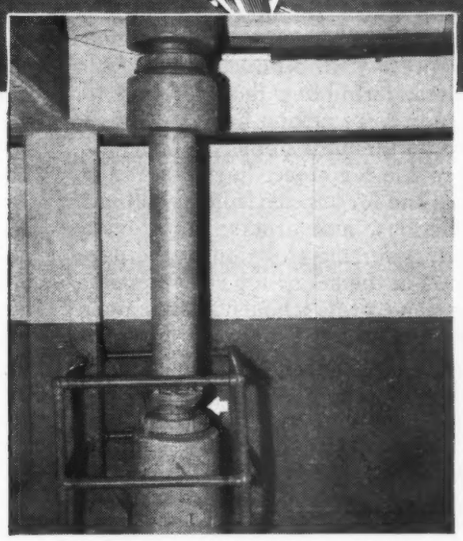

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Governor, a Chairman, the Attorney General, and the Land Commissioner could not give sufficient time to the running of the board since the discovery of numerous oil fields and gas fields had been made in the State. The necessity for regular meetings was so apparent that it was recommended to the Legislature that a new law should be enacted with members of the Board being appointed to carry on the regular work.

The new Law, known as House Bill No. 80, Chapter No. 256, was drawn as an act to prevent waste, to foster, encourage, and provide conservation of crude oil and natural gas and products thereof, and to protect the vested. co-equal and correlative rights of owners of crude oil and natural gas; to create a state oil and gas board; to provide for the appointment of a state oil and gas supervisor charged with enforcing the act and all rules, regulations, and orders made by the board; to fix the compensation of the members of the board; to provide for the employment of personnel; to vest the board with jurisdiction and authority necessary to administer and enforce effectively the provisions of the act; to authorize the board to promulgate rules and regulations and issue orders for the enforcement of the provisions of the act and to prevent waste; to regulate the production of oil and gas as between wells within a field, pool, or area, forbidding the proration of oil and gas as among fields, pools, or areas on the basis of market demand; to provide for proceedings before the board and for appeals from its rulings, regulations, and orders; to provide penalties for the violation of the provisions of the act or the rules, regulations, and orders issued thereunder; to regulate persons, firms, or corporations running oil in the State of Mississippi, and buying and purchasing same; to authorize the state oil and gas board to enforce its regulations and this act; to provide for the cycling of gas, repressuring, pressure maintenance, and secondary recovery operations; to provide for pooling or unitization and integration of interests; to repeal all laws in conflict with this act; and other purposes.

The law set out a declaration policy, which is as follows: It is hereby declared to be in the public interests to foster, encourage, and promote the development, production, and utilization of the natural resources of oil and gas in the state of Mississippi; and to protect the public and private interests against the evils of waste in the production and utilization of oil and gas by prohibiting waste as herein defined; to safeguard, protect, and enforce the co-equal and correlative rights of owners in a common source or pool of oil and gas to the end that each such owner in a common pool or source of supply of oil and gas may obtain his just and equitable share of production therefrom; and to obtain, as soon as practicable consistent with the prohibition of waste, the full development by progressive drilling of other wells in all producing pools of oil and gas or of all pools which may hereafter be brought into production of such, within the state, until such pool is fully defined.

It is not the intent nor the purpose of this law to require or permit the proration or distribution of the production of oil and gas among the fields and pools of Mississippi, on the basis of market demand. It is the intent and purpose of this law to permit each and every oil and gas pool in Mississippi, to be produced up to its maximum efficient rate of production, subject to the prohibition of waste as herein defined, and subject further to the enforcement and protection of the co-equal and correlative rights of the owners of a common source of oil and gas, so that each common owner may obtain his just and equitable share of production therefrom.

It provides for the creation and the establishment of a board of five members, the Governor appointing three, the Attorney General appointing one, and the Lieutenant Governor appointing one member. Not more than two members can be appointed from each of the United States Court Districts. The Lieutenant Governor and the Attorney General appointments were to be for a period of four years. The appointments of the Governor were to be staggered, one member for a period of two years, one for a term of four years and one member for a period of six years.

Governor Fielding L. Wright appointed W. C. Leonard of Kosciusko, Mississippi, for a period of two years, and he appointed Ex-Governor Hugh L. White, for a term of four years. James McClure, Jr. of Sardis, Mississippi, was appointed for a term of six years. Lieutenant Governor Sam Lumpkin appointed Walter Johnson, Jr., of Jackson, Mississippi, for a term of four years. The Attorney General appointed William H. Maynard of Clarksdale, Mississippi, for a term of four years.

On May 9, 1948, the new Board, as constituted above, was sworn in. They immediately went into session, and elected James McClure, Jr., of Sardis, Mississippi, as chairman of the Board, and W. C. Leonard of Kosciusko, Mississippi, as vice chairman. The Board, as constituted by the Statute, was not to be composed of oil men and they were not to know anything about the oil industry. They elected a supervisor under the old board, as supervisor and secretary to the Board, and retained the office help, as constituted.

Each member of the Board was to receive a compensation of $20 per diem, for not to exceed 120 days per year. The duties of the Board are set out in the Statute, as are the duties of the Supervisor, and prescribing other additional help necessary, in carrying out the provisions of this law. The Attorney General, in all cases, is the attorney for the Board. However, in cases of emergency, or in special cases, at the request of the Attorney General, an additional attorney can be employed.

It became apparent to the Board, that much work had to be done by them, in drawing up the rules and regulations and procedures before the board. After several months of deliberation, and thoughtful study, with the assistance of the operators and oil men, within and out of the state, a set of rules and regulations and procedures were drawn up and adopted on October 29, 1948. These rules and regulations also carried with them the necessary forms that were to be submitted to the Board as prescribed. The rules and regulations of the several fields were revised in the light of the new law, and in conformity with the state-wide rules adopted at the same time.

The Board has set aside the third Thursday in each month, as a regular meeting time to carry on the oil and gas business of the State. The Board has met in numerous extra sessions and has made several revisions to the rules and regulations as first adopted. Only minor changes have been made in the original rules and regulations.

The House Bill No. 80, repealed all of the laws pertaining to the Oil and Gas, and also the act creating the $25 drilling fee. The Legislature, however, passed another act very similar regarding the paying of a fee of $25 for a permit to drill an oil or gas well.

For operating the State Oil and Gas Board, the Legislature passed the Senate Bill No. 574, chapter 318, an act to levy and assess a charge against the oil and gas produced and saved in the State of Mississippi, for the purpose of paying the expenses and cost of administering House Bill No. 80. The levy amounts to 2 mills per barrel of oil and 1/10 mill per cubic foot of gas.

The Board has a pamphlet, "Conservation of Crude Oil and Natural Gas, Laws of Mississippi 1948, Rules of Procedures and State-wide Rules and Regulations and Special Field Rules" that may be had for the asking.

* * *

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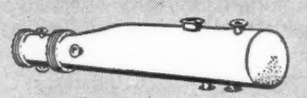

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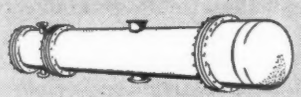

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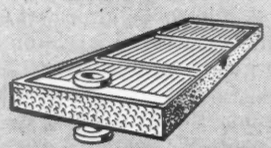

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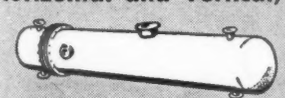

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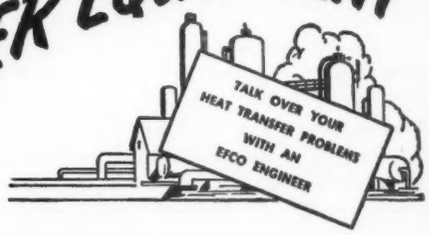


P 986.5

Conservation Practices in Mississippi

J. K. WRIGHT, JR.

THE MISSISSIPPI Laws of 1948 declare that it is the policy of the State Oil and Gas Board to foster, encourage, and promote the development, production, and utilization of the natural resources of oil and gas in the state and to protect the public and private interests against the evils of waste in the production and utilization of oil and gas; also to safeguard, protect and enforce the co-equal and correlative rights of owners in a common source or pool of oil and gas to the end that each owner may obtain his just and equitable share of production; and to obtain, as soon as practicable, consistent with the prohibition of waste, the full development by progressive drilling of other wells in all producing pools of oil and gas or of all pools which may hereafter be brought into production within the state, until such pool is fully defined.

Further, it is the intent and purpose of the law to permit each and every oil and gas pool in the State to be produced up to its maximum efficient rate of production, subject to the prohibition of waste as defined by the law, and subject further to the enforcement and protection of the co-equal and correlative rights of the owners of a common source of oil and gas, so that each owner may obtain his just and equitable share of production therefrom.

On April 1, 1949, the Board employed a technical staff to fill out its organization and at the same time began the consideration of the allocation of oil and gas production in the various fields and pools within the state. The Board has a regular meeting every third Thursday of each month and in its May, 1949, meeting called up the first field for the adoption of special field rules and the establishment of allowable production.

The Board set its first allowable production, after notice and hearing, for the Mallalieu Field, Lincoln County, effective June 1, 1949. In this first hearing to establish allowable production the Board adopted special field rules for the Mallalieu Field and set a temporary allowable of 200 bbl per day per 40 acre drilling unit for a period of three months. During the interim of this temporary allowable the engineers of the Board conducted monthly pressure surveys to determine the pressure results with a change of production rates. The field had an initial pressure of 4684 psi and in a little more than two years the pressure had declined to approximately 3000. During the period just prior to the setting of temporary allowables the pressure was decreasing at the rate of 2½ psi per day. The reduction in production rates caused the pressure decline in the field to be retarded to less than ½ psi per day. At the close of the test period and after a second hearing held on this field August 18, 1949, the Board established a daily allowable for the Mallalieu Field at 150 bbl per day per 40 acre drilling unit. These allowables are set on a month to month basis and may be changed as the facts may warrant, after hearing before the Board and consistent to the maximum efficient rate of production, subject to the prohibition of waste.

Effective July 1, 1949, the Board promulgated field rules and established temporary allowables for the LaGrange field, Adams County, and adopted a regular allowable of 125 bbl of oil per day per drilling unit for the Pine Ridge field, also in Adams County.

Effective August 1, 1949, the Board adopted special field rules and set temporary allowables for the South LaGrange field of Adams County, and the Hub field of Marion County. At the present time the Board has up for consideration the adoption of special field rules and the establishment of allowables for the Baxterville field, Lamar and Marion Counties, the Soso field, Jasper and Jones Counties, and the Carthage Point field, Adams County.

Rapid progress is being made concerning the adoption of special field rules and the establishment of allowables in the various oil and gas fields of Mississippi. The Board, after setting temporary allowables in a field, has instructed its engineers to make a thorough monthly survey of the reservoir on which temporary allowables have been established. Even though there is considerable production pressure history on these reservoirs, the Board has the attitude that all factors should be seriously considered before the establishment of a regular allowable for a field or pool and that a close observation of these pools during a temporary allowable period will better enable the Board to determine the proper maximum efficient rate of production for the field and thus make their allocation for production according to the provisions of law.

The majority of the fields in which allowables have not already been set have their production controlled by pipe line restrictions or the particular fields have been unitized. The Heidelberg field and the Eucutta field are fields in which allowables have not been set at this time but which are under pipe line restrictions. Prior to

The Author

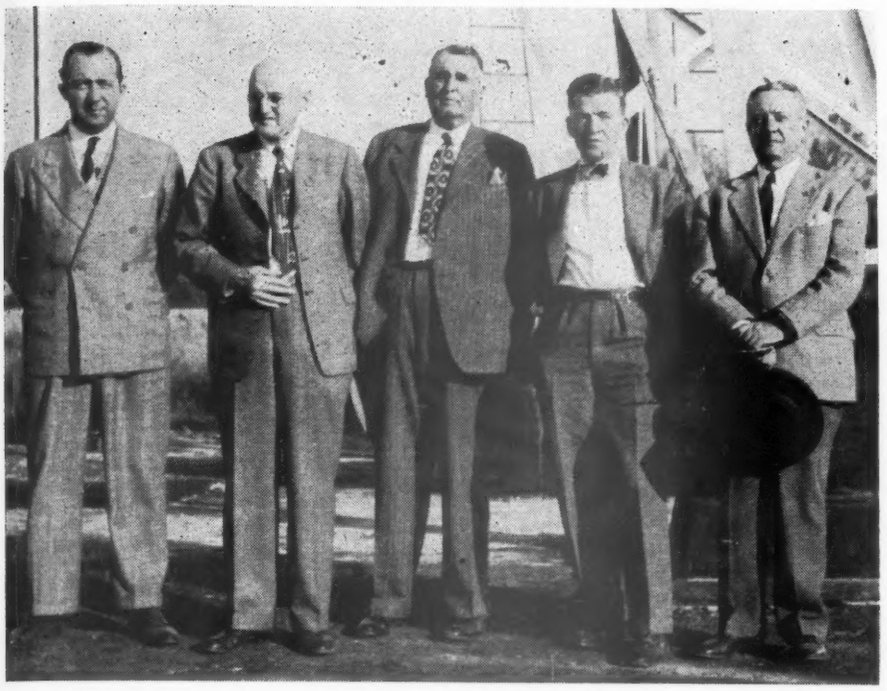
J. K. Wright, Jr., received a B.S. degree in petroleum engineering from the University of Oklahoma. In 1936 he went to work for the Phillips Petroleum Company and remained in the production department of this company until the spring of 1943 when he resigned to accept the position of petroleum engineer for the McAlester Fuel Company in Magnolia, Arkansas. In January, 1945, Wright became chief engineer for the Mississippi Oil and Gas Engineering Committee, Jackson, and later served as Director.

Effective April 1, 1949, the physical activities of the Mississippi Oil and Gas Engineering Committee were revised and Wright with his staff was employed by the Mississippi State Oil and Gas Board. In this new capacity as chief engineer he will head the technical and statistical work of the Board.

Wright is a member of the Supply and Demand Committee of the IPAA, the Topical Committee on Production Technology of the API and the Conservation Committee of the Mid-Continent Oil and Gas Association. He serves as a Membership Committee Vice Chairman of the Petroleum Division of the AIME.

EXCLUSIVE

MISSISSIPPI STATE OIL AND GAS BOARD



J. K. Wright, W. C. Leonard, Hugh L. White, W. H. Maynard, James McClure.

December, 1948, the wells in these two fields were allowed to produce, by pipe line allocation, a maximum of 150 bbl per well per day. During the month of January, 1949, the pipe line restrictions on the wells of these two fields were reduced to a maximum of 50 bbl per well per day. Reservoir pressures on these fields have been taken at 6-month intervals during the past two years and on a recent survey conducted during the forepart of June, 1949, these two fields showed an increase in pressure of approximately 100 psi.

In a similar manner, gas production from the Carthage Point gas field in Adams County was reduced approximately 50 per cent and that field has shown an increase during the past six months of nearly 70 psi. Therefore, it is evident that most oil and gas-producing reservoirs in Mississippi will react to production control and that the establishment of field production rates to the maximum efficient rate of recovery for the particular fields in the state should greatly increase the ultimate recovery of oil and gas.

Mississippi is accomplishing much from the standpoint of the proper conservation of oil and gas in the state and since it has already been shown that the majority of the fields in the state will react favorably to production control, it is evident that the Board will endeavor to establish as closely as possible, the MERs for the fields and to control the future production in the state so that the greatest amount of oil and gas production may be obtained for the benefit of the land owners, the state of Mississippi and the oil and gas industry.

Walter C. Johnson, Jr.

Board Members

During the short time that the new State Oil and Gas Board has been in existence it has made remarkable progress on conservation matters.

None of the Board members has been previously associated with the oil industry but high caliber business men were appointed. They have already made a good beginning of proving their ability to judge fairly for the state and for the oil industry. The members are:

James McClure of Sardis, an attorney, is chairman of the Board. He was appointed by Governor Wright, getting a six-year term. Jim attended Millsaps College, then went to Ole Miss for his A.B. and LL.B. degrees. After serving in the first World War, he began his law practice in Charleston, but two years later he moved to Sardis and has practiced there ever since. He is a past president of the University of Mississippi Alumni Association, and has served as a member of the Board of Trustees of higher learning, which governs all state-owned colleges.

Hugh White of Columbia, who says "put me down as a lumberman," was appointed by the Governor for a four-year term. He graduated from St. Thomas Hall at Holly Springs, and attended Ole Miss. He was elected Governor (1936-40) and inaugurated the Balance Agriculture with Industry program and is now serving as a member of the governing board. Although he dropped out of state affairs, officially, after his term as Governor, he was unanimously elected to the Legislature from Marion County for the 1944-48 term. In addition to serving on the BAWI (now the A. and I.) Board, he serves also on the State Building Commission, which will spend $26,000,000 for buildings and repairs and improvements at state-owned institutions in the next two years.

W. C. Leonard of Kosciusko, went into business for himself after he completed school and the W. C. Leonard and Company department store had its 44th anniversary last month. He is a leader in civic affairs and was awarded the "Outstanding Citizen" trophy in 1944 for community service. He is a vice president of the American Retailers Association. Governor Wright appointed him to serve a two-year term on the Oil and Gas Board.

William H. (Billy) Maynard of Clarksdale, vice chairman of the board, was appointed to a four-year term by Attorney General Greek L. Rice, under whom he has served as Assistant Attorney General. Billy received his A.B. and LL.B. degrees from Washington and Lee University and has practiced law in Clarksdale since 1928.

Walter G. Johnson, Jr. of Jackson, the youngest member of the board, is general manager and co-owner of the Jackson Daily News. He was appointed to the board by the Lieutenant Governor for a four-year term. He attended Staunton Military Academy, Braden School in New York City, and Ole Miss, going then into the Army Air Corps. He was shot down over Europe and spent 13 months as a German prisoner of war. He is active in Jackson civic and veterans' affairs.

* * *

P 350.18

Oil and Gas Engineering Committee

MISSISSIPPI has a better petroleum engineering background than most oil states. About five years after oil was discovered, the Mississippi Oil and Gas Engineering Committee was established and development was recorded and studied to determine the best engineering practices for the state.

All through the years 1945 to 1949 this non-profit group, made up of leaders of the oil industry working in Mississippi, gathered engineering data on the oil and gas reservoirs of the state and kept the industry informed so that development and production could be more efficiently carried out.

Thus in the interim between the time oil production first became a reality and the date when the state had enacted comprehensive conservation laws, the state had effective voluntary collection and distribution of reservoir engineering information that promoted efficient operations.

The idea of a state petroleum engineering committee was launched by D. V. Carter, chief petroleum engineer, Magnolia Petroleum Company. It was in 1944 when war demands held back organization of production departments in the state and there was no provision by the state itself to record all the reservoir data needed for development. Carter proposed the formation of a state-wide engineering committee as the most feasible method of gathering and distributing the information that was increasingly important to proper drilling and production methods.

After Walace Hawkins, chief counsel of Magnolia, decided the organization would not violate anti-trust laws, a series of organizational meetings were held. On January 12, 1945, the Mississippi Oil and Gas Engineering Committee came into existence as a voluntary, non-profit, unincorporated, petroleum engineering and statistical group, supported by membership fees.

There was a General Committee, composed of one representative from each company (or individual) that was a member, and an Executive Committee, composed of seven members and elected by the General Committee.

The organization began with the election of D. V. Carter as general chairman; L. H. Moore, Gulf Refining Company, as vice chairman, and M. E. Norman and C. L. Morgan, as secretary-treasurer.

Elected to the Executive Committee were: J. D. Davis, chairman, Union Producing Company; Paul F. Barnhart, Humble Oil and Refining Company; J. J. Bresenham, Jr., Magnolia; J. W. Gill, Hunt Oil Company; L. H. Moore, Gulf; A. S. Rhea, Sun Oil Company, and M. A. Wright, The Carter Oil Company.

Alexander Crowell was employed to handle the field and office work of the committee and three or four others were on the permanent staff. Surveys of the oil fields were made and records were gathered to be distributed to members and to be available in the files. Considerable data were gathered on operations made previous to the organization of the committee and Mississippi is said to have the most complete files of any state on its oil and gas reservoirs.

This information includes: Cumulative and monthly water produced, oil and gas figures on all individual wells in the state, well completions and such rework information as is available, severance tax collections, pipe line runs, gas sales, refinery activities, cycling plant activities, bottom hole pressure information, individual well tests, and other facts of interest to the oil operators in the state.

All these data were collected by the staff and published in a monthly bulletin that was sent to the members.

Funds to carry out the duties of the Engineering Committee were made up by a fee from each member. Non-producing members paid an annual set rate and producing members paid in proportion to their oil and condensate production in the state.

When a comprehensive state oil and gas conservation law was passed in 1948 it was realized that the state itself, in order to carry out the provisions of the law, would have to gather substantially the same information as the Engineering Committee had collected. To avoid this useless repetition of effort the Mississippi State Oil and Gas Board and the Mississippi Oil and Gas Engineering Committee agreed that the staff employed by the former would be taken over by the State Board and the work would be continued under state auspices.

D. V. Carter, Magnolia Petroleum Company, instigated the Mississippi committee that collected valuable statewide engineering data.

The reports are already being issued in substantially the same form as under the voluntary plan and members of the Engineering Committee continue to receive the information.

J. C. Posgate, Humble, headed the Committee when it was disbanded and its functions taken over by the state. A. S. Rhea, Sun, was vice chairman, and J. F. Snyder, Sinclair-Wyoming Oil Company, was secretary-treasurer. On the Executive Committee were: Joe T. Goodman, chairman, Gulf; D. V. Carter; W. F. Dalton, Placid Oil Company; J. D. Davis; W. F. Eating, Jr., Carter Oil; J. E. Howell, Lion Oil Company, and J. T. Reynolds, Sohio Petroleum Company.

J. K. Wright, Jr., who directed the engineering work of the Committee, became the chief engineer for the State Oil and Gas Board. Other personnel, J. F. Borthwick, Jr., statistician, and E. J. Burnet, engineer, continue their same duties with the State Board.

* * *

Competition--Key to Drilling Contractors Progress

THE American Association of Oilwell Drilling Contractors, comprising the men who own and operate about two-thirds of the 2400 contract rotary drilling rigs in the United States and Canada, is holding its ninth annual convention this month. The contractors, including their superintendents, toolpushers, engineers, accountants, and other personnel, are showing more interest in the association and its activities each succeeding year. Those who attend this annual meeting will hear what other contractors are doing to reduce drilling costs and accidents and to improve overall drilling efficiency. Those unable to attend may read the papers and reports of discussions on their mutual problems. All the people interested in drilling should discover new ways and means of improving their particular job or operation.

Although much may be said about record-breaking depths and the setting of tremendous weights of casing, competitive interest will be focused on the numerous everyday operations that take up so much ordinary rig time and increase cost. The spectacular drilling performances of the past year will receive due acclaim, but the primary attention of the contractors, their associates, and their customers—the oil producing companies—will be directed toward time-saving, cost-cutting methods and equipment that offer them an opportunity to make enough profit to stay in business.

Joe Morris, president of AAODC, ably describes the progress and aims of this relatively new organization of drilling contractors in an article in this issue. The annual meeting, the committee meetings, and the local chapter meetings provide excellent forums for the mutual problems of the contractors. The AAODC is serving not only the contractors, but also the petroleum industry and the people who use its products —by providing these forums and reports that enable the alert contractors to improve their drilling rig efficiency and thus reduce the cost of oil field development. Clean competition between drilling contractors is the key to their outstanding progress in drilling straighter holes faster and deeper than ever before.

K Marshall Fagin

Here are the Facts about CENTERING CASING

Only through the effective centering of your casing in the open hole can you obtain a sufficiently uniform annular cementing space to permit distribution of the cement slurry completely around the casing. Under this condition the hazard of channeling is minimized, and the best opportunity for success of the installation is present.

When you run a Baker Model "G" Casing Centralizer you can rest assured that it will do a proper centering job. You need no longer worry about trial-and-error centering of your casing, because the Baker Centralizer is a proven centralizer with many exclusive as well as desirable features:

1. It exerts maximum centering force where it is needed—not as the centralizer first enters the well bore, or above the first well constriction, but after the most rugged trip to the bottom of the hole, at the point where the actual centering job must be done.

2. Its springs are designed on the basis of maximum spring centralizing efficiency alone, without any interference from complicating factors.

3. Its springs are *never* forced to deflect over the sharp edge of a ring or collar, since they are *butt-welded* (not lap-welded or riveted) to the Spring Collars; and the Stop Rings are positioned safely *outside* of the spring assembly area. Thus the casing supports the total centering force by direct contact with the springs.

4. As its springs deflect, their active length decreases. They are thereby stiffened and their centralizing action is increased.

5. All of its springs are compressed simultaneously as a unit and cannot be deflected individually.

6. Its mounting design permits rotation of the casing even under adverse conditions, and within annular clearances smaller than can be approached by any other centralizer.

7. It is, in effect, scientifically "tailor-made" to produce optimum characteristics for each individual casing range.

8. It starts easily, and the Baker "tailor-made" feature eliminates the need for snubbing.

9. It is easy to install on the pipe. No on-the-job sizing or adjusting is required. Everything is pre-positioned so that the unit may be merely slipped on the casing and welded in place.

10. It is always PULLED (never pushed) as it is run-in the hole. This averts the danger of distorting or otherwise damaging the springs while raising or lowering the casing string past restrictions in the hole.

All of these features contribute to the fact that the Baker Model "G" Casing Centralizer yields greater centering force than any other spring-type casing centralizer within desired annular clearance ranges over the entire area to be cemented.

COMPARISON IS INTERESTING

You will find it both interesting and instructive to fill in the CHECK CHART on the opposite page, which brings out the important facts about "centralizing."

EXCLUSIVE

General Geology of Mississippi

FREDERIC F. MELLEN

Introduction

THE general geology of Mississippi* has been known since the first geological thinkers observed the surface outcrops in the state. They determined the general rates of dips, the stratigraphic sequence of formations, determined the direction (strike) of the outcrop belts by tracing fossil zones and lithologic units, and determined rough correlation of formations with those of other states and countries by comparison of rock types and fossils. In the middle years of the 19th century, Wailes, Harper, and Hilgard published their general reports on the geology and agriculture of the State of Mississippi. Hilgard, whose ability soon became nationally and internationally known in the field of agricultural geology, made two important ecomonic discoveries that were not realized until long after his death.

In Hilgard's report of 1860 he described the Jackson structure 70 years before gas was discovered on it and described the bauxite of northeastern Mississippi before this ore of aluminum was known to science, 61 years before its discovery in Mississippi. In August, 1860, a year after Colonel Drake's oil discovery in Pennsylvania and before the anticlinal theory was advanced, Hilgard wrote:

"Yet we find lignitic strata cropping out on Moodys Branch, a mile N.E. of the State House, and that at a hypsometrical level obviously higher, than that at which, a mile below, we find the beds of blue fossiliferous sand cropping out on Pearl River and in the bed of Dry Creek. Making due allowance for the undulations of the surface at both stations (Canton and Jackson), the surface of the lignitic strata, so far from exhibiting a southward dip, is still slightly higher at Jackson than at Canton. It seems difficult to account for this condition of things unless by supposing a local upheaval of the underlying formation."

Thus was first described a productive structure now known to have over 300 ft of closure on the surface Eocene strata, 2500 ft of closure on the top of the Cretaceous, and about 10,000 ft of closure on the top of the Jurassic.

In 1931 Arnold and Kemnitzer in their volume, "Petroleum in the United States and Possessions" reported that of the 46,865 square miles in Mississippi, 83.2 per cent was "favorable" for oil accumulation and 16.8 per cent was "unfavorable." Such an empirical land classification is only relative, and is unjust to the authors as well as to parts of the state. Their percentages have been widely used and have visibly affected or predicted the subsequent wildcatting. The four counties that have never been drilled for oil nor gas, Benton, Coahoma, Quitman and Tunica, are in the northern Mississippi area where they considered the possibilities low or nil.

The 1929 figures available at their writing showed that only 123 wells had been drilled in the search for oil since 1903, contrasting with the current annual completion rate of around 400 wells. Most of the early wells were shallow and would not now be considered adequate tests. In the present light of a few deep tests into Paleozoic and into early Mesozoic sediments, it would be hazardous to say that any portion of Mississippi is "unfavorable." Rather, the terms "less favorable" or "unknown potentialities" would be better substitutions.

The Author

Frederic F. Mellen has his BS degree from Mississippi State College and a Master of Science degree from University of Mississippi. He did geological work with Tennessee Valley Authority, Mississippi Geological Survey, Work Projects Administration, Agricultural Adjustment Administration, Eastern Clay Products, Inc., and The British-American Oil Producing Company, and was a former assistant state geologist of Mississippi. His geological work has been mostly in Mississippi, Alabama, Arkansas, Illinois, Kentucky, and Tennessee.

Mellen is well known for finding the structure on which the first oil field in Mississippi was found, the Tinsley field. He discovered the Tinsley Dome in February, 1939, and oil was found on the structure in September, 1939.

Structural Composition

Two diagrammatic cross-sections have been presented that show the general geology of Mississippi better from the oil man's point of view, than a series of contour, isopach or areal geologic maps. The section in eastern Mississippi, (Fig. 1) shows the stratigraphic relationship of Paleozoic formations, ranging in age from Cambrian to middle or late Pennsylvanian. The larger subdivisions of the Mesozoic, ranging from Jurassic Smackover to Cretaceous, overlap the underlying units progressively, and extend across the more steeply dipping and truncated Paleozoic formations. Only in the northeasternmost county, Tishomingo, do Paleozoic strata reach the surface in Mississippi. Here they range in age from Devonian to Upper Mississippian, and Dr. W. C. Morse, state geologist, in working out the stratigraphic succession, has shown that numerous structures are present and that many of the surface limestone and sandstone strata are saturated or stained with petroleum residue.

This East Mississippi section shows alternating major structural features, which have been indicated as the Nashville Arch, the Black Warrior Basin, the Central Mississippi "Ridge," the Mississippi Interior Salt Basin, the Wiggins "Ridge," and the up-dip edge of a Miocene Basin indicated to lie in Gulf waters off the Mississippi shore. The most conspicuous boundary between these structural features is between the Black Warrior Basin, and the Central Mississippi "Ridge" where a thrust fault of 15,000-20,000 ft of uplift is suspected. Here the Cambro-Ordovician dolomite is brought up in juxtaposition to the middle or upper Pennsylvanian shales. The section shows a composite of 31,800 ft of sedimentary rocks, and many

*Map on Page E-22 shows surface geology.

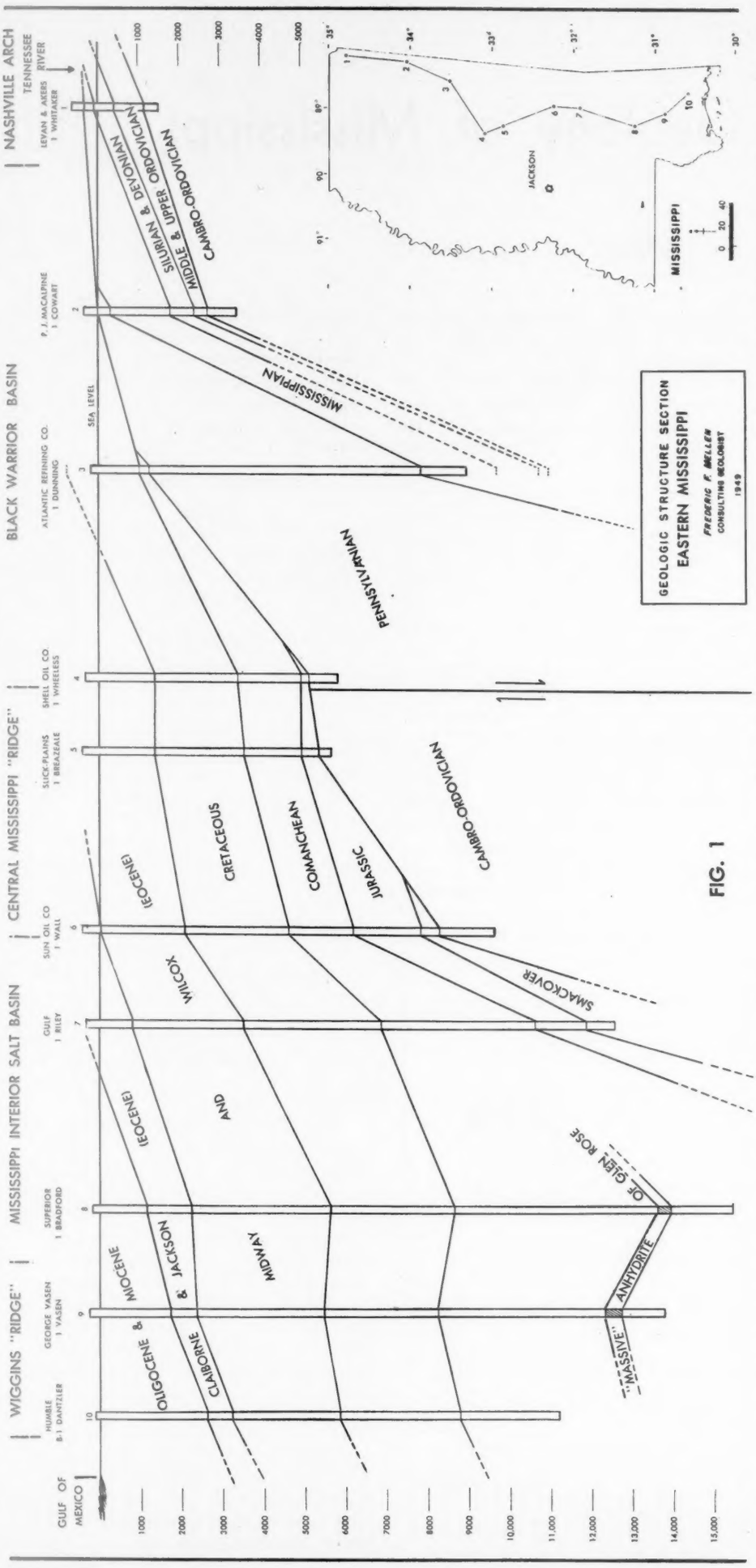


FIG. 1

more thousands of feet are indicated by projection. No igneous rocks have been reliably reported from eastern Mississippi.

In the West Mississippi diagrammatic section (Fig. 2) 27,500 ft of sedimentary rocks are shown, again with many more thousands of feet indicated by projection and restoration of section in the truncated areas. Like the other, this section shows an alternation of major structural features, the Black Warrior Basin, the Greenville-Desha Basin, The Sharkey (Monroe) Platform, the Mississippi Interior Salt Basin, the Wiggins "Ridge," and the Miocene Basin.

In western Mississippi from the Sharkey Platform northward wells penetrating the Mesozoic and Paleozoic commonly encounter igneous rocks. Albert Kidwell is currently finding that diabase intruded in rocks of late Paleozoic age in Tallahatchie County is very different from the alkaline rocks intruded in Mesozoic sediments on the Sharkey Platform, and concludes that the diabase may be of late Permian or Triassic igneous activity as it is in eastern Texas, southern Arkansas, and eastern Alabama. Kidwell's work is a good example of the type of research work that is being done by the universities, governmental organizations, and technical departments of the oil companies. From such studies long range correlations and conclusions can be made that have definite economic significance in petroleum exploration.

Stratigraphic and Lithologic Composition

Limestones and dolomites are prevalent from the Cambro-Ordovician up through middle Mississippian. Minor percentages of shale, sandstone, and chert are found in these early and middle Paleozoic beds. Numerous unconformities can be demonstrated. Oil and gas shows have been common in these beds and it may be expected that they will in time produce prolifically as they have in many other parts of North America.

From the middle Mississippian through the Pennsylvanian the section is principally clastic, shales, sandstones, and quartz conglomerates. Minor beds of limestone and coal are found in the upper Mississippian and Pennsylvanian. The Amory Gas Field, the first production in Mississippi, was discovered in 1926 and produced for a few years from a Mississippian sandstone. Other wells in both Pennsylvanian and Mississippian have had shows of oil and gas and many of the sandstones have indicated porosity by encountering salt water.

Sedimentary rocks of Permian age

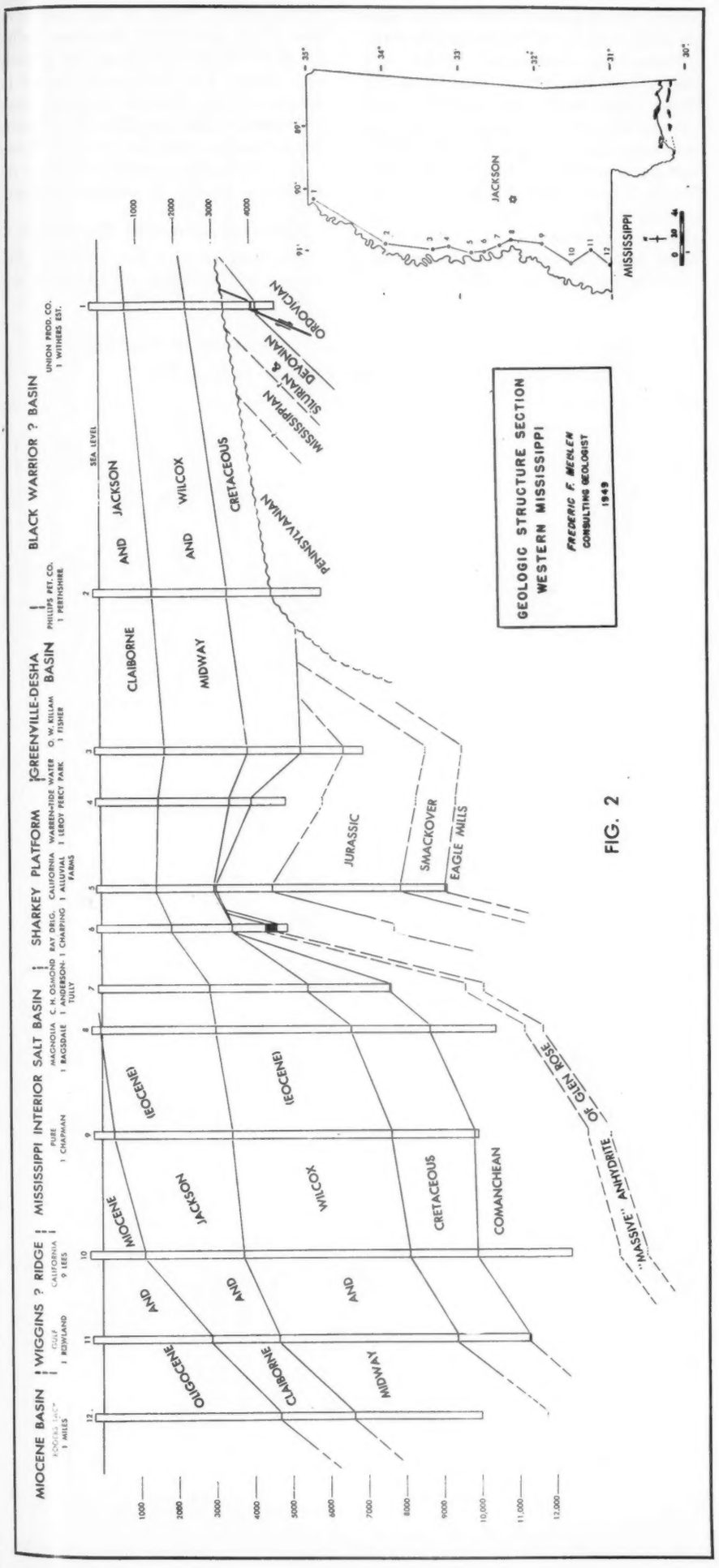


FIG. 2

are unknown. Widespread mountain growth in the Appalachian and Ouachita belts during this period possibly yielded sediments for Permian rocks deeply buried in south Mississippi.

Sedimentary rocks of Triassic age are unknown. As in the case of the Permian, Triassic sediments may be deeply buried in south Mississippi. The diabase igneous intrusions reported by Kidwell are the only known rocks of probable Permo-Triassic age.

The Mesozoic Group is composed dominantly of clastic sediments, conglomerates, sands, and shales, a large percentage of which are red, or varicolored. Evaporates, salts and anhydrite, form a relatively small part of the total section, and may be entirely confined to the Eagle Mills, the oldest known Mesozoic formation. Limestone is found principally in the Smackover formation of the Jurassic and the Selma series of the Cretaceous. Very minor percentages of limestone are known in the Comanchean.

The Jurassic system is represented by the Eagle Mills, the Smackover, the Buckner, and the Cotton Valley, rocks much more perfectly known in Arkansas, north Louisiana, and Texas. The salt of the Eagle Mills has supplied the energy that formed most of the producing structures in Mississippi, and all the piercement salt domes in the Interior Salt Basin.

The Comanchean system composes a sharply expanded wedge of sedimentary rocks, containing conglomerates, "red beds," shales, some anhydrite, and minor quantities of limestone. Continental type sediments predominate, but much marine material in south Mississippi has been found. The system is becoming divisible into units correlative with units in Arkansas, North Louisiana, and Texas where they crop out.

The Cretaceous system is made up of the Lower Tuscaloosa formation, the Upper Tuscaloosa formation, the Eutaw formation, and the Selma series. These units have been divided into members and facies, and have been correlated with formations throughout the Gulf Coastal Region. Correlation of the first three formations is based principally upon stratigraphic position and lithologic peculiarities aided immensely by the use of electric well logs. Correlation in the Selma is based in large part upon the micro-fauna contained in the impure Chalks. The system is thickest in the Interior Salt Basin in Southeast Mississippi and thins to a feather edge and is locally absent on the Sharkey (Monroe) Platform. Sedimentation of gravels, sands, red shales and gray shales, continued to the close of Upper

Tuscaloosa time. Above the Tuscaloosa, red shales are practically absent in Mississippi. The Eutaw is composed normally of 400-600 ft of alternating glauconitic sands and dark-gray shales.

In early and middle Selma time wide-spread volcanic activity, which probably began in early Upper Tuscaloosa time, reached its maximum intensity, resulted in the formation of the Jackson Dome and the Sharkey (Monroe) Platform and produced a reworking of earlier sediments. The reconstructed history of the Cretaceous shows some of the reasons for oil accumulation in Mississippi and indicates other favorable areas for exploration.

The Midway and Wilcox of the Eocene system reached a maximum development in Southwest Mississippi and a minimum development in North Mississippi at the Tennessee line. The Midway is entirely marine and is largely dark-gray shale. Sand lenses are locally developed in it along the Wiggins Ridge. It is separated from the Wilcox by an unconformity, indicated by the development of a laterite soil zone: the Arkansas and Mississippi bauxites are on this contact and can be traced down dip into the subsurface. The Wilcox is made up of dark shales or clays, abundant lignite seams, and countless sand bodies. Limestone and marl are less common constituents but are interspersed throughout the section.

The Claiborne and Jackson of the Eocene system are more marine than the Wilcox though both units carry thick continental type silts and sands and lignite seams. This unit attains maximum thickness in west-central Mississippi and thins eastward to and beyond the Alabama line.

The Oligocene and Miocene systems are made up of the Vicksburg, Catahoula, Hattiesburg, and Pascagoula formations. The subsurface indicates a sharply expanded wedge into the Miocene Basin of South Louisiana and the Continental Shelf under the Gulf of Mexico. These beds are composed mostly of silts, silty clays, and impure sands. Limestone and marls are prevalent in the Vicksburg, but appear as less important constituents in the overlying formations.

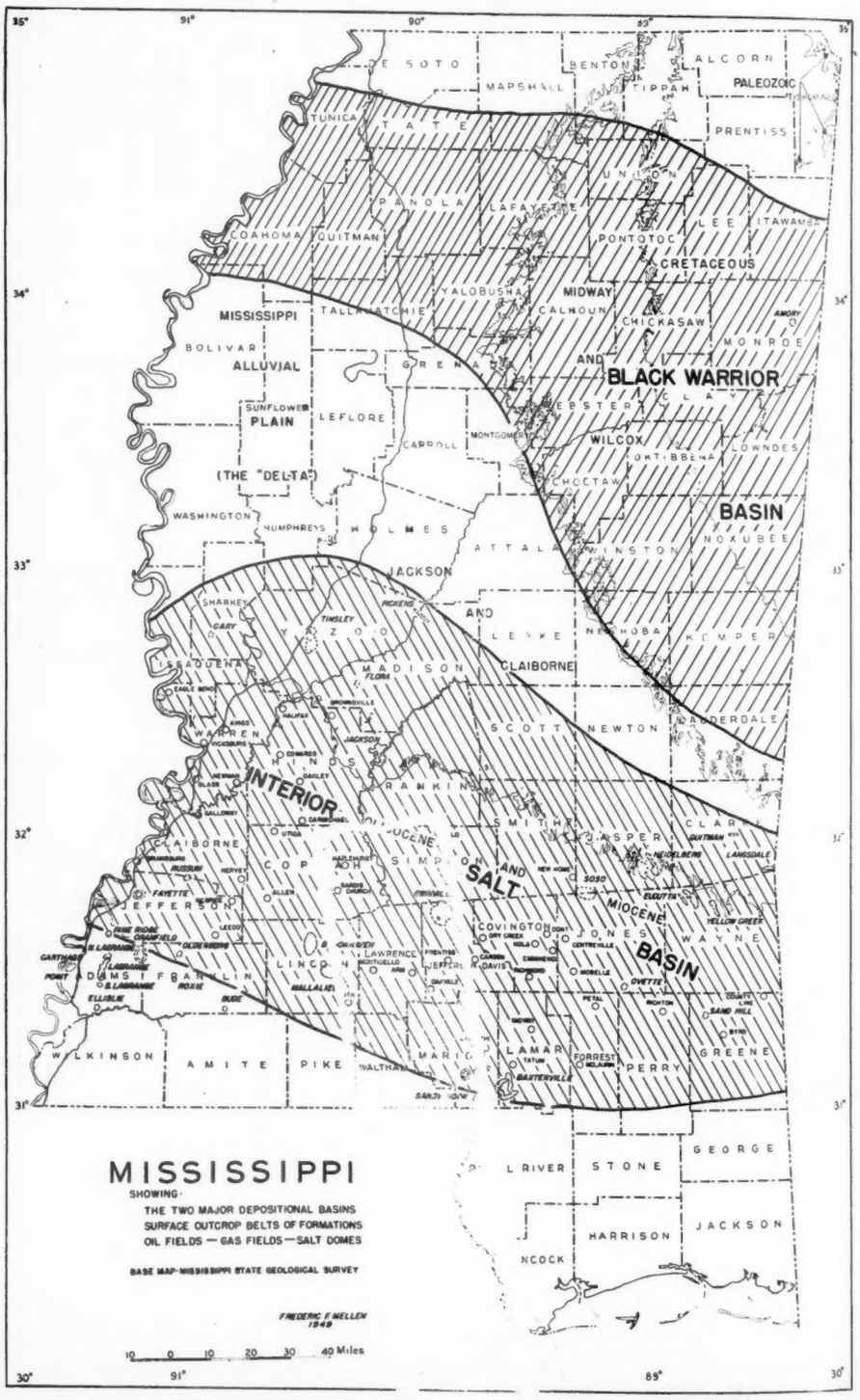
Economic Development

Mississippi is wealthy in its resources of clays, sands, gravels, lignites, limestones, waters, natural gas, and oil. It is one of the largest producing states of bentonite used for refining oil, drilling mud, and for bonding foundry sands. Its common surface clays have been used for over 100 years for manufacturing brick, and its great variety of higher grade clays promise new industries, which can also utilize the fuel gas and oil of the State. The sands and gravels used principally for concrete mix and road surfacing have supplied employment and some wealth for many years. The lignite is undeveloped. The limestones in various parts of the state are suitable for agricultural and other purposes and crushed lime is being supplied by the state at nominal cost for soil-building. None of the resources have been adequately developed with the possible exception of the gravels and water. The waters are found in all parts of the state at relatively shallow depths and provide the farmer, the industries, and the municipalities with a valuable mineral resource on which no royalty is paid or claimed.

Retrospection and Prognosis

Mississippi is in the younger generation of the family of oil-producing

FIG. 3. Geologic and oil and gas development of Mississippi. Salt domes are circles. (See map page E-22.)



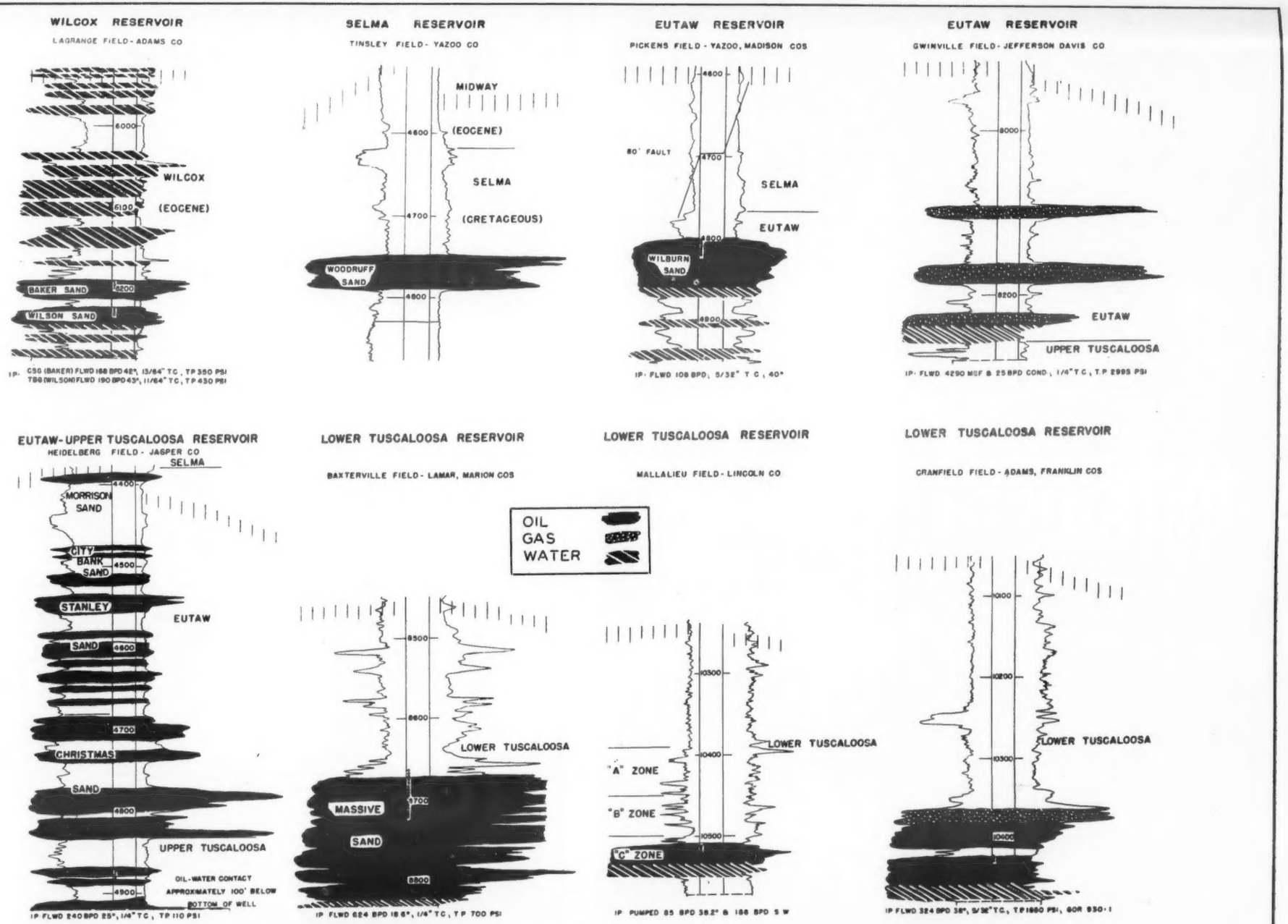


FIG. 4. Electrical characters of some Mississippi oil and gas reservoirs.

states. Its first wildcat test was drilled after many of the states had been producing oil for decades. Unlike most states no very shallow oil fields have been found to give impetus and incentive to development and deeper drilling in productive areas. Mississippi has suffered and enjoyed the lean and the fat years that are known universally to the petroleum industry. After the 1926 discovery of the small Amory gas field, followed by the 1930 discovery of the Jackson gas field, she seemed to be on the way to real development. The simultaneous discovery and expansion of the East Texas field, however, caused a sudden withdrawal of capital from the state that was destined to set her back nearly a decade. The fortunate part of this delay was the improvement of drilling equipment and techniques that were so necessary to the deep drilling in Mississippi.

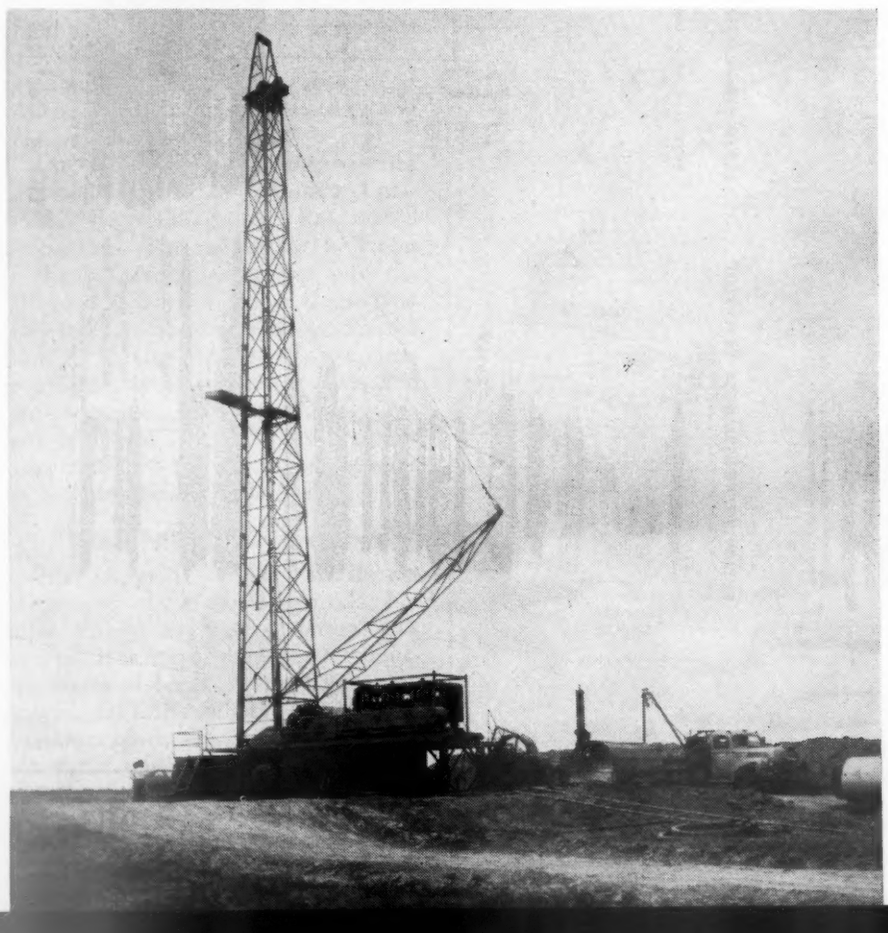
We have been fortunate, too, that the great bulk of our drilling has been since the invention and perfection of electrical logging devices. The electrical log has been invaluable and should unquestionably be credited for many of the discoveries in the state, either directly or indirectly. Surely, had not this tool been available, many sands now producing oil or gas would have been passed up in drilling. The electrical characters of some of the oil and gas reservoirs are shown in Fig. 4.

A variety of exploration methods are in use today. Surface geology, the first method in use, and for a number of years the most successful, can still be advantageously employed in some areas to check geophysical or subsurface anomalies. The gravitymeter has had remarkable results in the Interior Salt Basin in defining the deep-seated and shallow piercement salt domes. The seismograph, mostly reflection, is primarily responsible for some of the discoveries where gravity values are weak and surface geology is inadequate. The magnetometer has proved valuable chiefly in defining buried igneous masses in west-central Mississippi.

With careful interpretation of electrical logs we can expect to find possible productive sands in wells formerly abandoned as dry. The increasing density of dry wildcat tests and the detailing of producing structures by drilling, are now adding subsurface geology as an important exploration method, which should help in improving our discovery ratio.

About 85 per cent of Mississippi's oil production now comes from the Cretaceous and about 15 per cent from the Wilcox. A very small fraction of one per cent comes from the Comanchean. Thus, the greater part of our oil is produced from less than one-tenth of our combined sedimentary section.

Magnolia Petroleum Company drills wildcat in Madison County.



It can be expected that perhaps as many more large structures as now produce, such as Heidelberg, Tinsley, Baxterville, or Cranfield, remain to be discovered. Perhaps less than half of our Cretaceous reserves have been discovered. Such an estimation would have been reckless and unwarranted in 1940 or 1941 when many experienced geologists were wondering if there were any large fields in the state other than Tinsley.

It may also be expected that oil will be produced from the other geologic units. Scarcely a well is drilled in the Paleozoic area that does not have shows of oil or gas. The relatively shallow depths to Paleozoic objectives should partly offset the lack of subsurface and surface structural control. The Smackover limestone has been definitely identified in a well at Tinsley, a well in Issaquena County, two wells at Heidelberg, and has shown oil in all four of them. With favorable structure and facies there is little doubt of productive possibilities of this horizon in Mississippi.

The overlying Buckner and Cotton Valley of the Jurassic, and the entire Comanchean section, offer possibilities that have been little explored. Numerous shows, and a small amount of oil and gas production in three fields have resulted from a relatively few tests into the Comanchean. The chief deterrent to development is the great depths at which the oil-bearing facies of the Comanchean and Jurassic lie. Extension of the producing Wilcox belt in Mississippi may be expected and it is a question of time until profitable production will result from more complete exploration of the Claiborne. The possibilities of production from the Oligocene and Miocene in the extreme southern edge of the state are not to be ignored.

For the first time Mississippi's position as a leading oil-producing state is secure. Geological outlook indicates large reserves that are as yet unproved. It also indicates that many horizons that at present are unproductive will produce oil and gas profitably. Our foresight must be tempered by our hindsight; we must take advantage of our past mistakes to make a better record. One of the most necessary items in the improvement of our discovery ratio is more thorough sampling and examination of cuttings, cores, and electrical logs during drilling and before abandonment of any wildcat test.

The writer acknowledges with thanks the helpful suggestions and criticisms of Jarvis Garst, Honolulu Oil Corporation, and of David C. Harrell, Sun Oil Company.

* * *

Chief problem in Pickens field was transportation in wooded swamps, which required clearing before board roads were built.

P 305.

PICKENS FIELD, MISSISSIPPI*

FRED T. HOLDEN

In 1940 Mississippi was in its infancy as an oil-producing state. Not until late 1939 had its first oil field, Tinsley, been discovered, thereby relegating to the back row the pessimists who had loudly proclaimed that Mississippi could never produce oil. With the impetus provided by the Tinsley discovery, a boom began in leasing and wildcatting for oil in Mississippi. It was natural that the drilling activity of the early 1940s centered on prospecting the geologic structures in the central part of the state near the Tinsley Field.

Competitive leasing was done in the Pickens area in December 1939 and January 1940 by major oil companies and independents on the basis of surface geology. Geophysical coverage was begun at the same time.

One of the most difficult operation problems in the Pickens area, both with respect to geophysical coverage and to subsequent drilling, was the moving of equipment. Many of the early wells were in densely wooded swamps that required considerable clearing and the laying of board roads.

The first well drilled was the Sinclair Wyoming Oil Company-Kingwood Oil Company et al No. 1 R. E. Wilburn, 430 ft south and 330 ft west of the northeast corner of Sec. 31-T 12NR3E, Yazoo County. Its location was based on seismograph mapping and the well was spudded on March

*See map Page E-22 for location of field and table on Page E-59 for recent data.

EXCLUSIVE

11, 1940. Oil saturated sand was cored in the top of the Eutaw formation at a depth of 4885 to 4892 ft, and on April 9, 1940 the well was completed as a new oil discovery flowing 1013 bbl of 38 API gravity oil and 183 bbl of salt water a day through open 2-in. tubing. Seven-inch casing had been set at 4873 ft, 1 ft above the top of the oil sand, and production was from open hole through perforated tubing set at 4887 ft.

Some controversy over the naming of the field developed. The Mississippi Geological Society named it the Pickens field. The Mississippi Oil and Gas Board at first called it Vaughn field because, while Vaughn and Pickens are about equally distant, the discovery well was in Yazoo County, as is Vaughn, and Pickens is across the county line in Holmes County. Later the board adopted the name Vaughn-Pickens, but through usage the field today is referred to as Pickens.

Sinclair and Kingwood jointly completed three more producing wells in the first Eutaw sand (the Wilburn sand) by the end of June, 1940. Then in September 1940 they drilled two dry holes, the No. 5 and No. 6 R. E. Wilburn wells. The limits of the field appeared at this time to be defined on the northeast by a fault and on the west and south by dry holes. No immediate attempt was made to drill along the strike of the fault.

THE AUTHOR

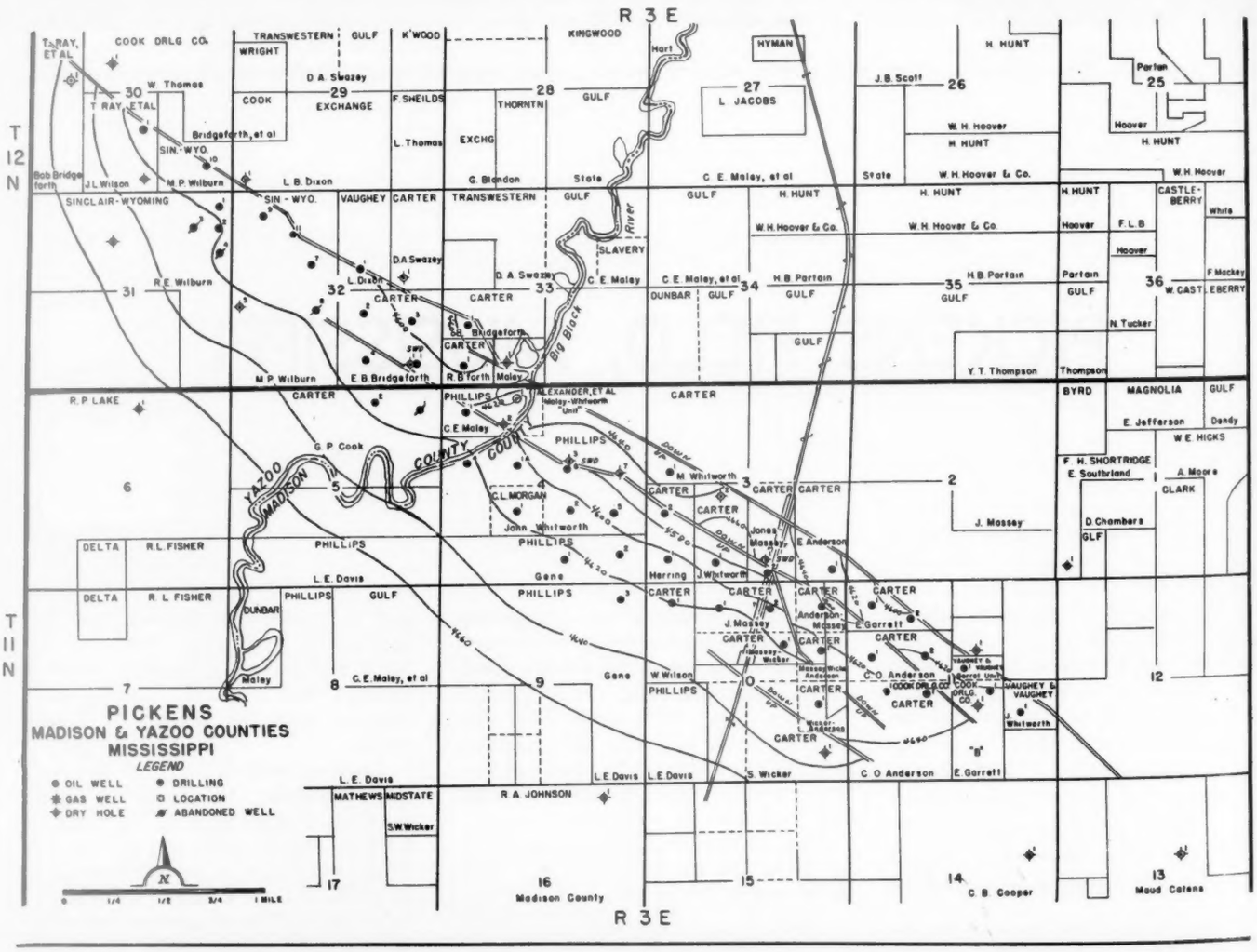
Fred T. Holden, received his A.B. in geology from Denison University at Granville, Ohio in 1937, did graduate work at Kansas University 1937-38, and at University of Chicago 1939-41 with Ph.D. in geology in 1941 from Chicago. He was assistant with Ground Water Branch of U. S. Geological Survey in central and western Kansas in 1938-39 and a subsurface geologist with The Carter Oil Company at Jena, Louisiana, and Shreveport, Louisiana, 1941-46. In 1946 he was named district geologist for Mississippi and Alabama for Carter Oil Company, the position he now holds.

Holden is a member of Phi Beta Kappa and Sigma Xi honorary fraternities, American Association of Petroleum Geologists, Society of Economic Paleontology and Mineralogy, Mid-Continent Oil and Gas Association, and Mississippi Geological Society, of which he is secretary for 1949-50.

In order to avoid drilling the wells into water none of the first 4 producers were drilled below the water oil contact. The two dry holes were drilled through the Eutaw into the underlying Tuscaloosa formation, and in each of these holes the Wilburn sand section was found to consist of approximately 45 ft of sand.

The next drilling activity began in October 1941 with the spudding of the C. L. Morgan No. 1 Johnny in the NE SW Sec. 4T11N-R3E. This location was 2 miles southeast of the nearest producer at Pickens and the operation was classified as a wildcat. On December 4, 1941 the well was completed in the Wilburn sand flowing at a rate of 264 bbl of 39.9 API gravity oil a day through a 1/8-in. tubing choke with 235 lb tubing pressure and 410 lb casing pressure. This well was viewed as a new field discovery and the name Sharpsburg was given it. Subsequent development saw the two productive areas merge into a single field and Sharpsburg was dropped in favor of the prior name Pickens.

Following the completion of the Morgan No. 1 Johnny, development was continuous throughout the suc-



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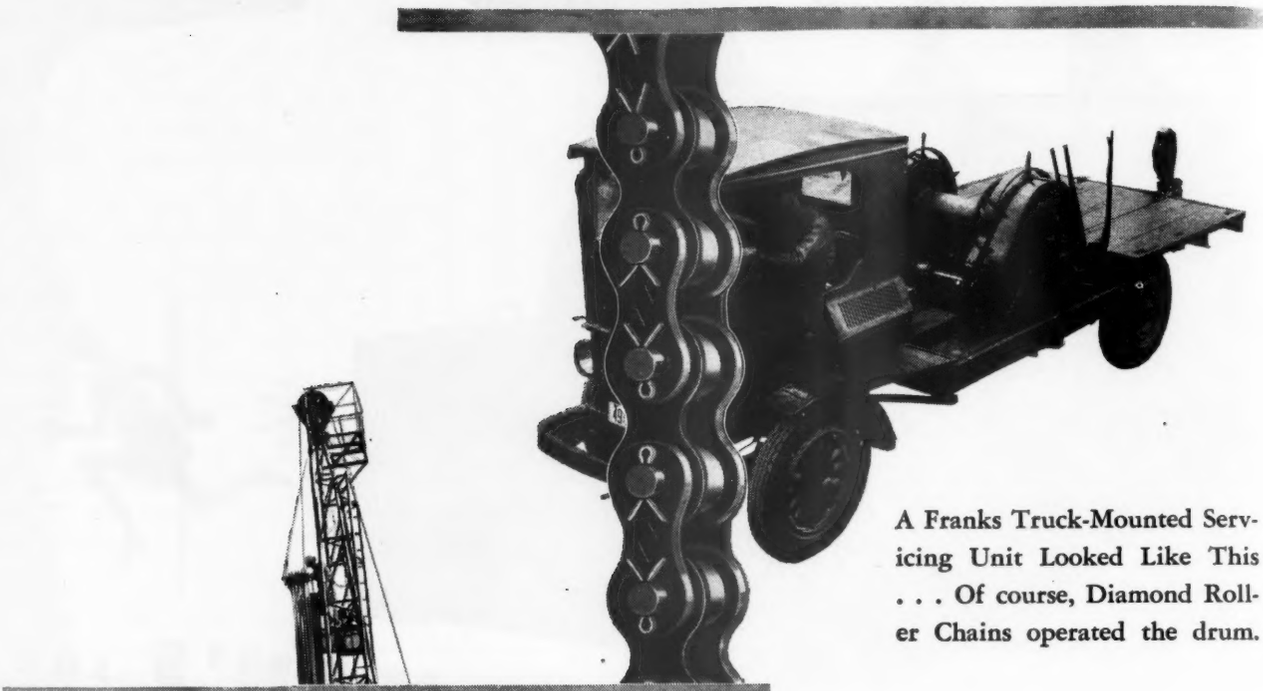

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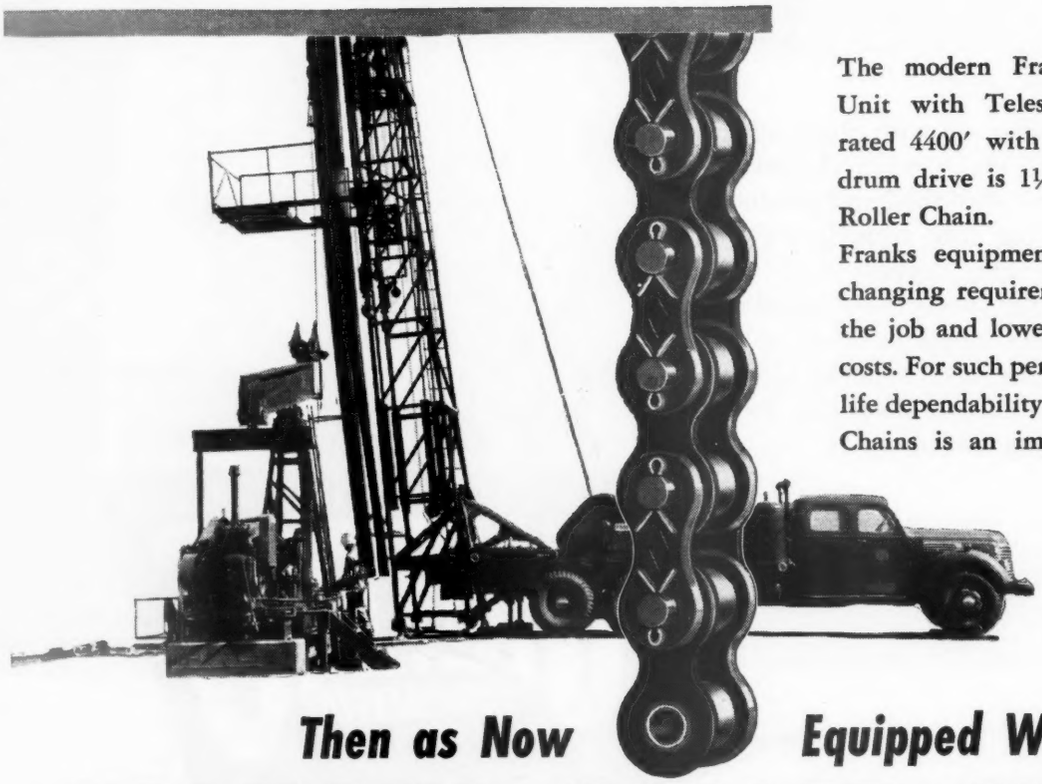

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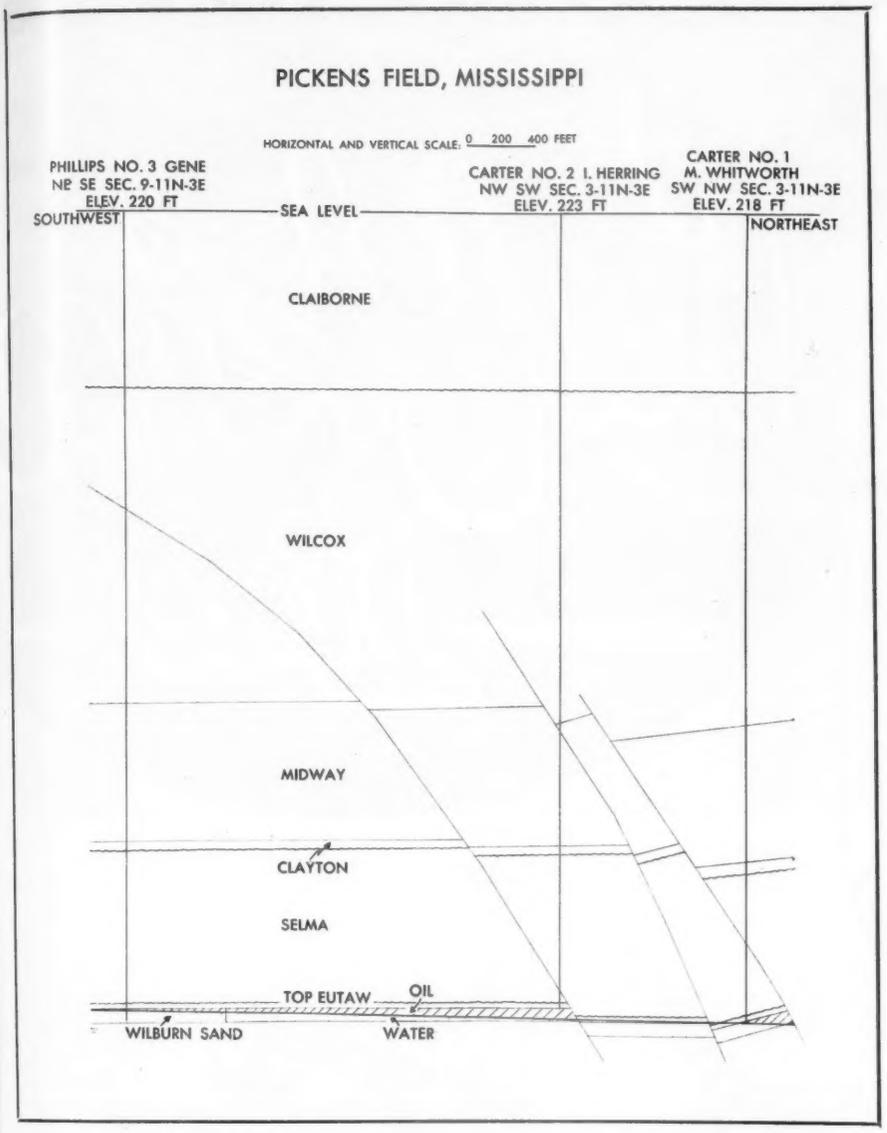

ceeding years until the final (51st) producer was completed in June, 1947. As of June 1, 1949, 43 wells were still producing at an average for the field of 75 bbl of oil per day per well.

The structural nature of Pickens caused it to be a hazardous venture for development. At its widest the productive zone reaches 4000 ft, and its average width is 2500 ft. Faulting complicates the structural pattern because of the varying and unpredictable amounts of throw along the fault strike. These two factors, narrow bank of production and faulting resulted in the drilling of a high percentage of dry holes. In the process of defining the productive limits of Pickens a total of 16 dry holes was drilled, a ratio of approximately 1 dry hole for 3 producers.

The Wilburn sand is a uniform body on the Pickens structure. In the northwest half of the field a thin shale body, from 2 ft to 5 ft thick, is persistently present approximately 10 ft below the top of the sand. Below this shale the sand is well developed through a thickness of 35 ft.

Reservoir requirements are well met in the Wilburn. In its typical development the Wilburn is a grey, fine-grained, glauconitic, micaceous, hard, slightly calcareous sandstone. Occasionally it is found to be sparingly fossiliferous. Permeabilities in the sand range as high as 1400 millidarcies, but they average approximately 400 millidarcies, both horizontally and vertically, in the non-calcareous development of the sand. Calcareous zones have been found developed to a thickness of 3 ft with a permeability range of from 0.0 to 30 millidarcies. These zones are very few and are discontinuous; therefore they do not have an adverse effect on the drainage of the reservoir.

Porosities in the Wilburn sand have been measured to as high as 38 per cent. Core data show an average porosity of 28 per cent.

It soon became apparent from the early producing history that the reservoir was affected by an active water drive. Individual well performance substantiated core data that high vertical permeabilities would cause water coning if proper completion procedures were not used. To permit the highest recovery from each well the operators adopted a program of exposing only the upper portion of the pay section above to water oil contact to the extent that water production could be properly controlled. Open hole and gun perforation completions were used; both proved to be satisfactory. In addition to close control of completion procedures it was also necessary to restrict production from the pool to take advantage of the higher oil recoveries afforded by the efficient use of the active water drive.

Until May 15, 1943 all wells were produced at high rates, estimated to be near capacity. Since then many of the wells in the field have been produced at less than their capacity for the reason that engineering data at hand indicated that reduced producing rates were essential if the reservoir was to be properly protected. Total accumulated production for Pickens to May 31, 1949 was 11,766,270 bbl.

The bottom hole pressure declined from an original pressure of 1875 psi, in April 1940 to 1600 psi at the end of 1943. In November 1944 the pressure was 1234 psi. A slight increase to 1251 psi was registered May 1945. Since then the decline has been steady to below 900 psi.

The gas-oil ratio in the Pickens field has always been low. Initially it was 140 cu ft per bbl. In May 1949 the ratio was 75 cu ft per bbl.

Bottom hole temperature at the Wilburn sand level is 164 F.

The structure of the Pickens field is a fault block upthrow on the southwest. Several en echelon faults have developed with a northwest-southeast strike. The dip of the faults is northeast at an angle that increases from approximately 30 deg, at a depth of 1500 ft in the Wilcox formation, to 65 deg in the Tuscaloosa formation at an average depth of 5500 ft. The dip of the faults in the Wilburn sand varies from 45 deg to 50 deg. Similarly the amount of vertical displacement increases with depth. In the Zilpha formation (Eocene), at an average depth of 800 ft, the displacement varies from 5 to 15 ft; in the top of the Cretaceous, at 3900 ft, the displacement averages 40 ft and at the Wilburn sand level it averages 80 ft. The variations in dip and displacement made hazardous the drilling along the fault line. The variable tilt

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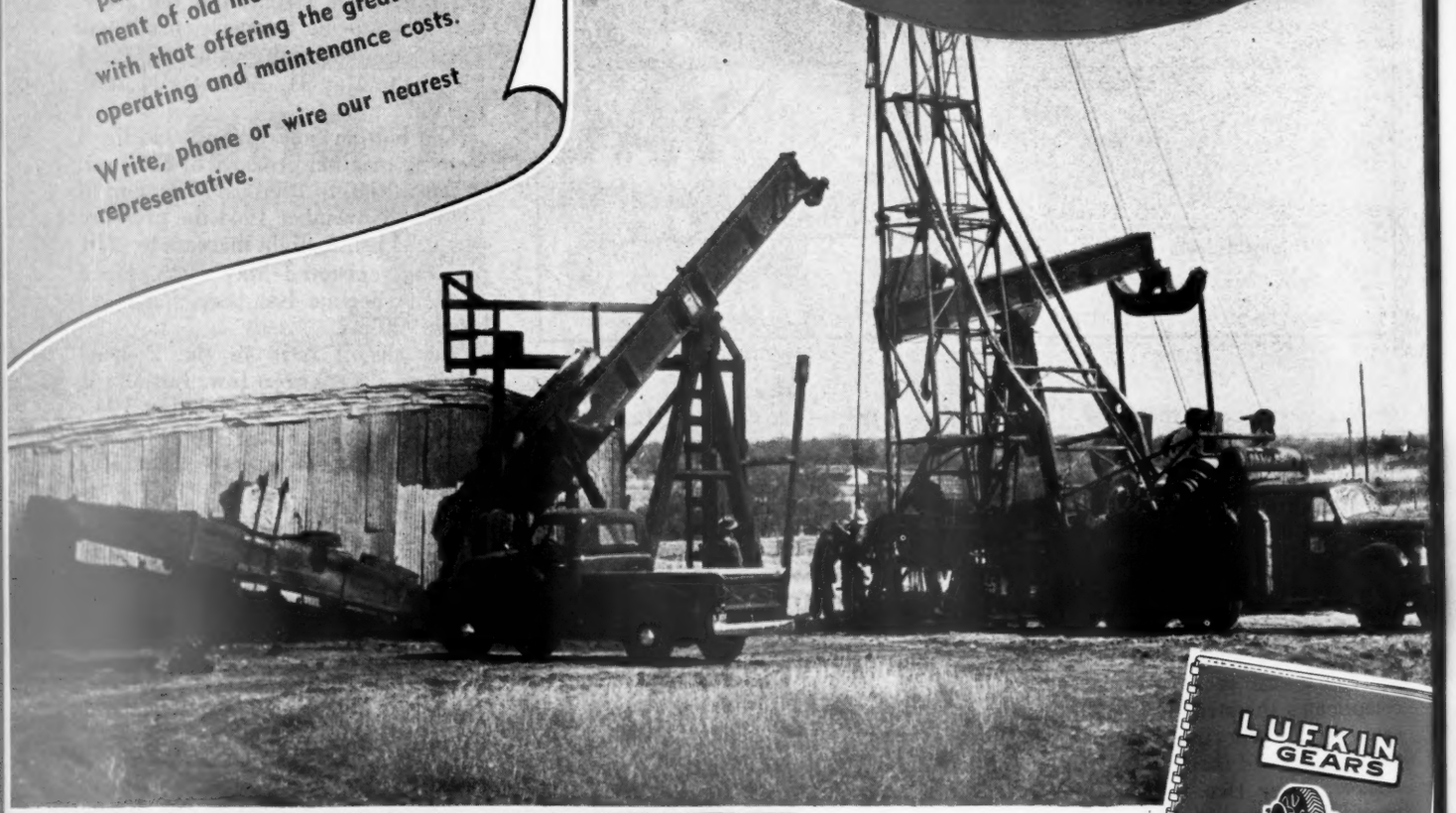

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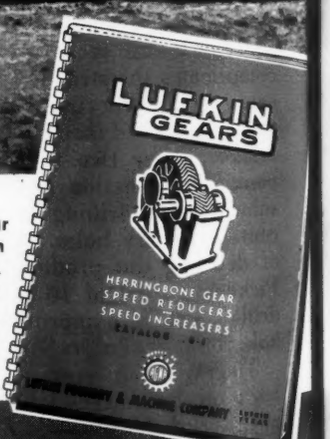

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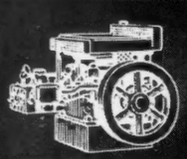

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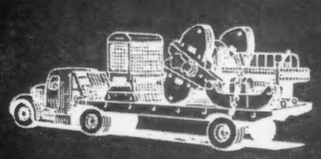

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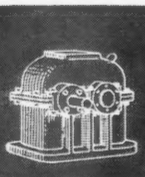

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Board road over swamps leads to well in Pickens field.

of the downdropped fault block increased the hazard and led to spotty production along the northeast limit of the field.

Production is found both on the highest (southwesternmost) fault block and on the first downdropped block to the northeast. The water level, which was originally at 4634 ft, is common to all the fault blocks. The average rate of dip on the upthrown fault block is southwest at 20 ft, in the 500 ft nearest the fault, flattening to 20 ft in 1300 ft at the outer limit of the productive area.

The dip of the first fault block to the northeast (the only downdropped block that produces oil) is southwest at an average of 20 ft in 800 ft.

The average thickness of oil sand at the well point is approximately 18 ft, and the thickness of oil section in the producing wells ranges from 7 ft above the original water level to 57 ft above water in the structurally highest well, The Carter Oil Company No. 2 Jones-Massey, S ½ SW SE Sec. 3-T11N-R3E.

The peak production of the Pickens field was reached in August 1944 when 38 wells produced 202,059 bbl of oil for the month, an average of 6518 bbl per day for the field and 171 bbl per well per day. Since that time the production decline has averaged approximately 9 per cent per month, the production for May 1949 being 99,781 bbl of oil from 45 wells or an average of 72 bbl per well per day. All wells in the field are pumping at capacity as of June 1, 1949, and no well produces over 200 bbl of oil per day.

The Pickens field is divided by the Big Black River, 31 of the producers being on the east side in Madison County and 20 on the west side in Yazoo County. A line of the Illinois Central railroad, passing through the western portion of the field, aids in transportation of the oil. U. S. Highway 51 passes through the eastern part of the field, leading to the town of Pickens, 5 miles north of the field, and to Canton and Jackson, 13 and 37 miles respectively south of the field.

Until December 30, 1943 the Pickens field was served by the Allied Pipe Line Company and the Sohio Pipe Line Company. On that date the Oklahoma Pipe Line Company took over from Allied. In 1945 the Oklahoma Pipe Line Company became the Interstate Pipe Line Company. At present, Pickens crude is piped through the Interstate gathering system to a loading rack, adjacent to the field. It is loaded in tank cars and taken to the Esso Standard Oil Company refinery at Baton Rouge, Louisiana.

A problem that early confronted the Pickens field operators was the disposal of salt water. During each of the 12 months of the period ending in March 1943 water production exceeded oil production. From March 1943 until the end of 1944 more oil than water was produced monthly, but since January 1945 monthly water production has exceeded oil production in an ever-increasing ratio. The latest available figures show that in February 1949 the total fluid production from Pickens was 322,877 bbl, of which 233,001 bbl was salt water and 89,876 bbl was oil.

The first salt water disposal well was put in operation in June 1942. The well used was the Phillips Petroleum Company No. 3 John Whitworth, SW NE Sec. 4T-11N-R3E. This well had been drilled into the Tuscaloosa formation to a total depth of 5555 ft and, being dry, it was plugged back to 3040 ft in the basal Wilcox formation. A sand and shaly sand section in the lower Wilcox was perforated from 2859 ft to 2958 ft. The well was completed at this zone as a salt water input well, taking 210 bbl of water in 3 hr under 7 points vacuum.

In October 1943 The Carter Oil Company No. 1 E. B. Bridgforth was drilled to a depth of 3000 ft and casing was perforated at 2880 ft to 2980 ft in a brackish water sand of the basal Wilcox. Salt water was injected into this sand at a rate of 180 bbl an hr. The following June further perforations were made at 2690 ft to 2760 ft in the lower Wilcox.

A third disposal well was put in operation in May 1944 when The Carter Oil Company No. 1 Jones-Massey, SW SE Sec. 3-T11N-R3E. in the southeast portion of the field was plugged back from a total depth of 6464 ft to 4380 ft. An effort was made to use the Wilburn sand, which here is on a downthrown fault block below the oil-water contact, as a salt water input sand, but the Wilburn would not take water under 1600 psi pressure. Perforations were then made in the lower Wilcox at 2850 to 2937 ft where salt water was successfully injected at an initial rate of 1820 bbl per day. ***

The Pickens field will have a deep test this fall. The Carter Oil Company has staked a location for a 11,000-ft well to test the Smackover lime in the field. Possibility of deep production in the field has long been a matter of interest.

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Progress and Aims of the AAODC

Joseph S. Morris of Allen and Morris, San Antonio, Texas, is president of the American Association of Oilwell Drilling Contractors.

JOSEPH S. MORRIS

FROM a very modest beginning in November, 1940, when a small group of men engaged in contract drilling of oil wells formally recognized the need for a combined approach to the many and varied problems facing their industry, the American Association of Oilwell Drilling Contractors has achieved widespread recognition for its membership among all segments of the oil industry.

Today, with more than 400 active sustaining members who operate about 1600 drilling rigs, out of a total of about 2400, and with a total membership of 1787, AAODC can recall the past nine years with considerable pride of accomplishment. Even more important, it can look forward with the knowledge that the year ahead will present an even greater opportunity to be of service to the drilling industry, specifically, and the oil industry, generally.

The steady growth of this Association, with more new members added every year, reflects an appreciation by oil well contractors throughout the country of individual benefits to be gained by joining together to attack and solve problems that could not be solved otherwise. Also important is the extent to which this association has, by its relations with other segments of the oil industry, achieved stature and recognition for its accomplishments, and overall objectives.

Aims and objectives of AAODC, as outlined in its charter, provide a broad foundation from which to build an ever increasing, and an ever improving service to the drilling industry. The motivating purpose of the Association to date, however, has been one of creating, improving, and strengthening relationships. Essentially, the efforts of the organization have been to promote a better understanding of the drilling industry by those who work in it and those who deal with it. Generally speaking, as the drilling industry performs its duties as an integral part of the petroleum industry, the relationships that result fall into four broad categories: Those between contractors; those between contractors and their employees; those between contractors and their customers; and those between industry and all levels of government. Many activities of the Association have been designed to affect beneficially these relationships.

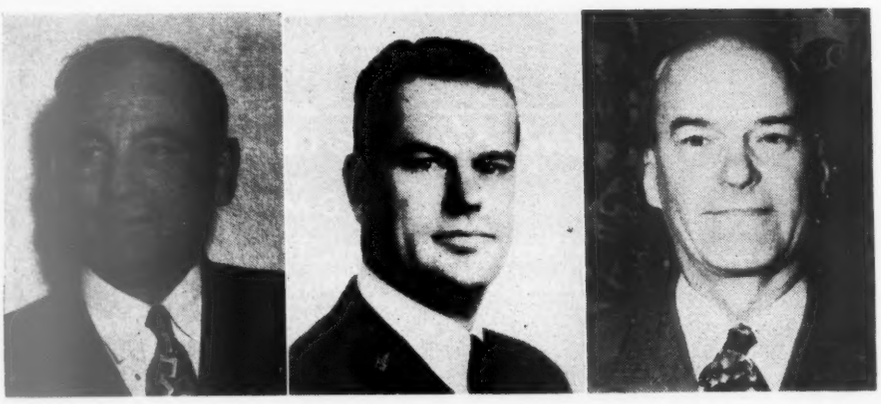
Probably the most important Association activities, which are responsible for its growth and development, are: Chapter programs, committee work, the safety program, the educational program, and the public relations program. These same programs have a direct bearing on the relationships with which the Association is concerned.

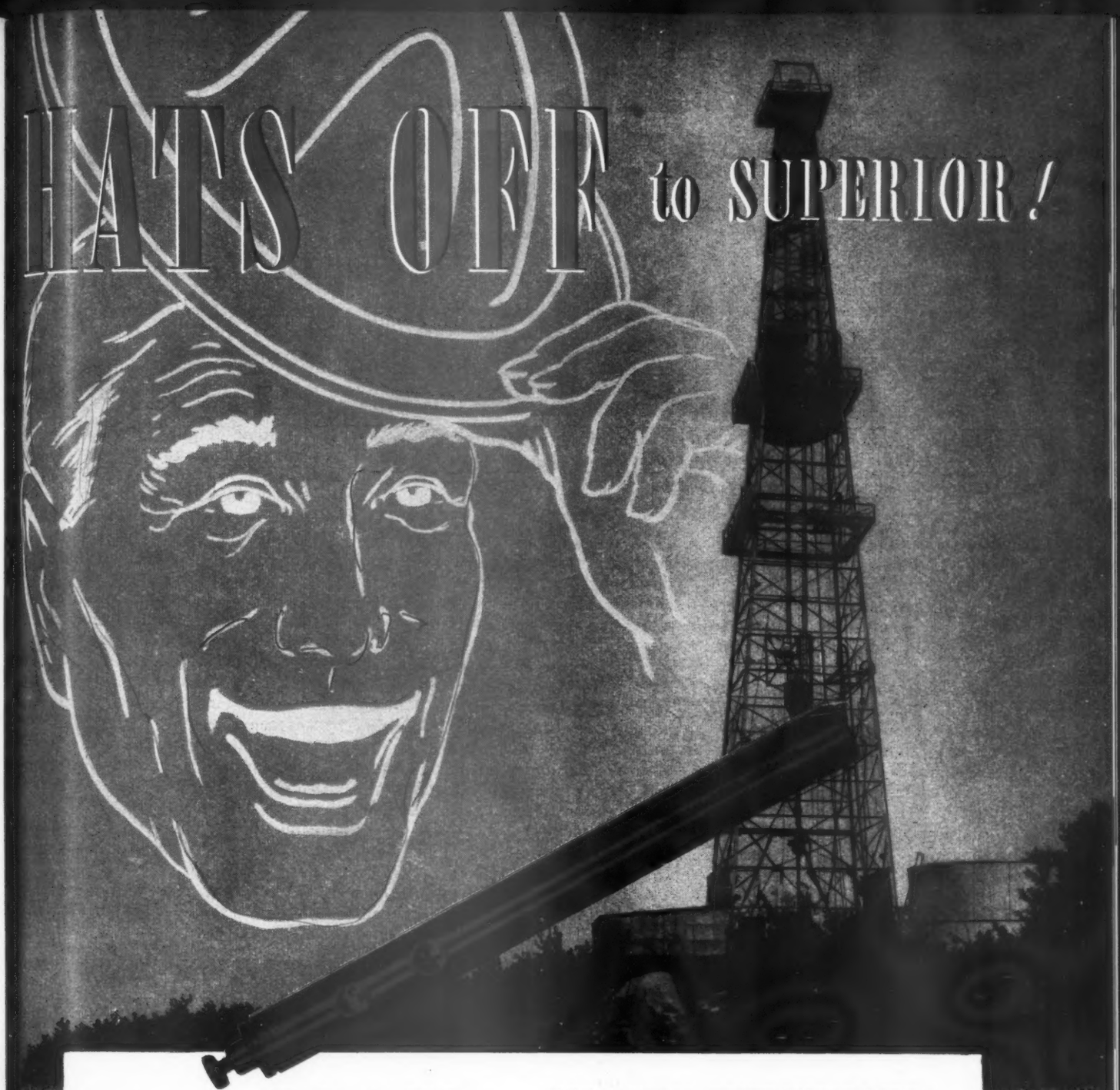
Chapter meetings and activities provide an opportunity for fellowship between contractors, a common ground for discussion and attack on mutual problems, and a better understanding of one another's problems. Chapter meetings, upon occasion, may also be attended by representatives of other branches of the oil industry for purposes of promoting understanding of mutual problems. At various times Association chapters have been very effective in promoting constructive relations with local government.

Working committees of the Association deal with specific problems affecting the drilling industry, as, for example, the development of an accounting manual by the Accounting Committee, which fulfilled a very definite need, and the continuing effort to improve employer-employee relations, as made by the Men and Management Committee. Work by these committees may affect one or more of the basic relationships outlined above, depending upon the project and the solution.

One of the earliest aims of the Association was to develop an effective safety program that would help the drilling industry reduce accidents among crews, increase efficiency of operations, and effect a reduction in costs. Sponsored by the Insurance and Safety Committee, this work was highlighted during 1949 by the Fourth Annual Safety Drilling Clinic in Dallas, May 24 and 25, with more than 200 contractors, drilling superintendents, drillers, tool pushers, and representatives of oil operators, service companies and manufacturers attending. Another feature, in addition to the monthly safety bulletins that are

Brad Mills, left, Dallas, Texas, AAODC executive vice president; J. Doyle Settle, Dallas, Texas, AAODC secretary; Louis A. Beecherl, McDaniel and Beecherl, Dallas, AAODC treasurer and chairman of General Arrangements Committee.





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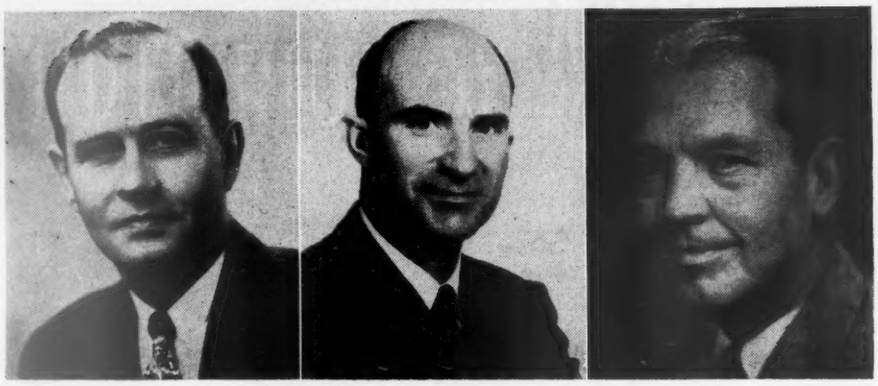


Carl Reistle, Jr., Humble Oil and Refining Company, Houston.

C. A. Oberg, Standard Oil of California, San Francisco.

J. L. Hamon, Cox and Hamon, Dallas, Texas.

sent out to 3700 contractors and oil operators and their personnel, was the issuance of 12 bulletins entitled "Safety and the Driller." These were designed to be of special benefit to the driller in helping him reduce accidents.

The safety program has not only produced a better understanding of accident prevention by contractors and field personnel, but has also been instrumental in strengthening contractor-oil operator relationships through joint participation in the programs.

Educational programs in general have been aimed primarily at furthering the basic objectives of AAODC. All of the Association's educational programs have affected beneficially the fundamental relationships outlined earlier. The employer-employee relationship is especially affected, as the training program objectives are to improve the quality of personnel and to enable that personnel to make more and better hole per dollar invested.

Educational work continued during 1949 on programs undertaken last year and two new projects were initiated. The overall program includes mud schools, drilling practice schools, management institutes, supervisory training, and drilling engine training. Here again, relations between contractors, their personnel, and other segments of the industry have been strengthened by opening enrollment in the schools and training programs to non-member contractors and their personnel, and to personnel of oil companies, service companies and manufacturers.

It is of interest that more than 1100 men took part during 1949 in schools teaching approved methods for the handling and control of drilling fluids. More than 5000 men have participated in the program since it was started.

Initiated during the year with marked success was a series of Management Institutes, undertaken by the Association with the cooperation of the University of Texas, Oklahoma A & M College, and the University of California at Los Angeles.

During the year the series of six conferences were held in each of 15 cities in oil producing centers throughout the country. Dealing with major problems of the drilling industry, and directed at the management level among operating personnel, the conferences included the following subjects: Functions of Management, Personnel Problems in the Drilling Industry, Management Responsibility in Accident Prevention, Application of Cost Factors in Drilling, Security for the Drilling Organization, and the Legal Position of the Drilling Contractor.

A total of more than 486 representatives from the drilling industry and from oil company personnel attended these meetings during the year. It is expected the program will be extended during 1950 to include other subjects and personnel unable to attend the first series.

A new educational program initiated by the Permian Basin Chapter of the Association in July, provides for drilling engine training of field personnel, with emphasis on care and preventive maintenance. More than 200 men were registered from this one area for the course that will offer instruction on engines and other equipment supplied by engine manufacturers, distributors, and service companies. Plans are being made to extend this program to other areas during 1950.

A very important phase of the Association's work is connected with efforts to solve problems that arise between contractors and oil companies in the fulfillment of drilling contracts. Reflecting the degree to which relationships between the drilling industry and its customers have improved in recent years, is the success of across-the-table discussions in working out solutions of these problems to the mutual satisfaction of both

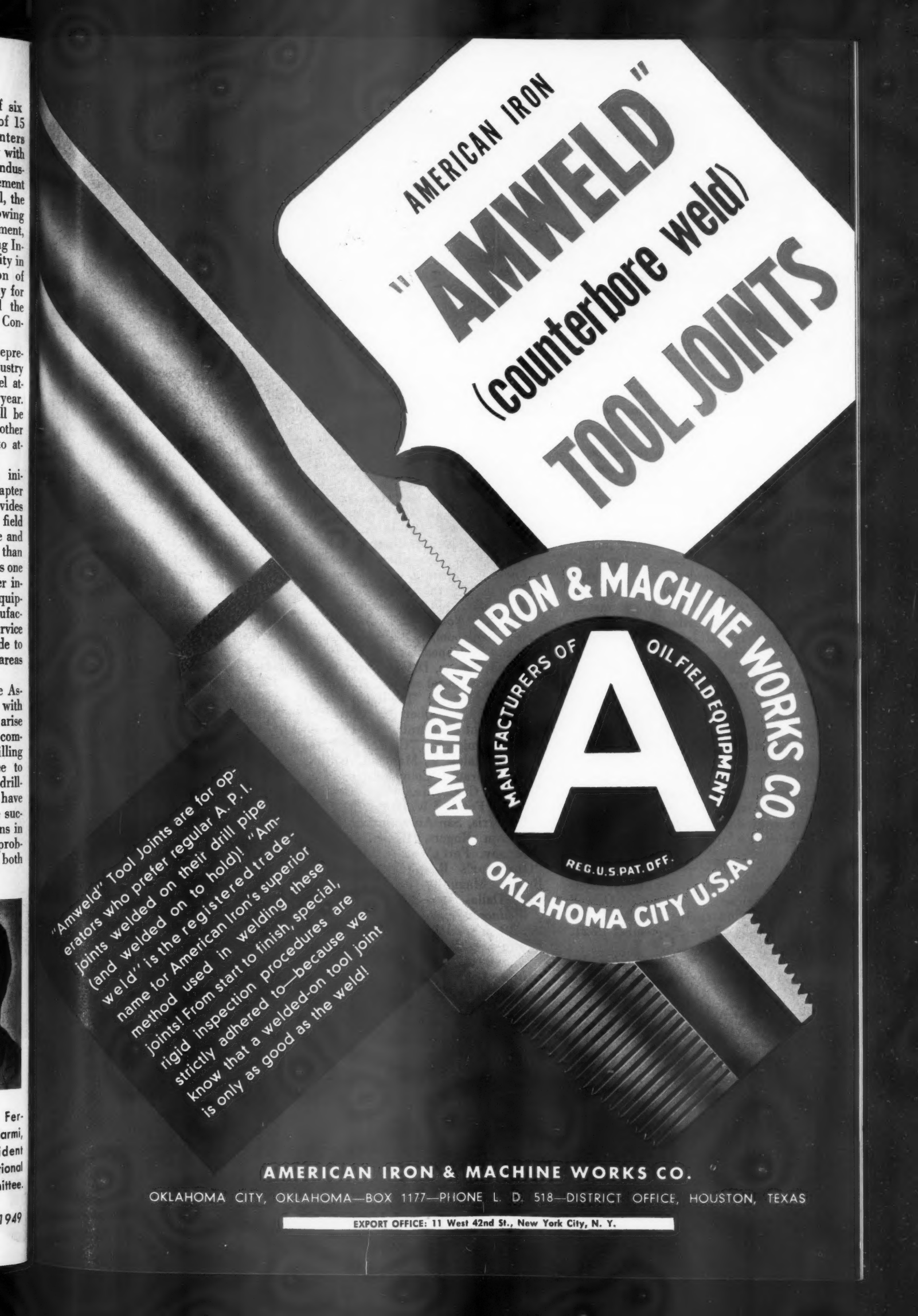
Frank M. Porter, Fain-Porter Drilling Company, Oklahoma City, Okla., vice president-at-large.

A. W. Thompson, Thompson-Carr, Inc., Houston, Texas, vice president for West Texas and New Mexico.

R. W. Wire, Loffland Brothers Company, Tulsa, Oklahoma, vice president for Central Mid-Continent.

Al Buchanan, Al Buchanan Drilling Company, San Antonio, Texas, vice president for Gulf Coast.

D. B. Ferguson, Ferbanta Drilling, Carmi, Illinois, vice president and chairman, National Cable Tools Committee.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Karl L. Kellogg, Karl L. Kellogg and Sons, Long Beach, California, vice president for California.

J. V. Dunbar, Salem, Illinois, vice president for Illinois, Michigan, Indiana, and Kentucky; chairman, Membership.

H. L. Rowley, Big Chief Drilling Company, Shreveport, Louisiana, vice president, Cretaceous and Tertiary Basins.

Zach K. Brinkerhoff, Jr., Brinkerhoff Drilling Company, Casper, Wyoming, vice president for Rocky Mountains.

C. F. Whaley, Chet Whaley Servicing Company, Houston, Texas, vice president for Well Servicing.

parties. Included within the scope of this activity is the development of standard clauses in contracts and the elimination of provisions from these contracts that have been found untenable under actual experience.

The Association has as a further objective, a program designed to bring about an understanding between operators and contractors on operating procedures that will ultimately result in simplification and standardization to mutual benefit, as related to costs and efficiency.

Consistent with a profound belief in our traditional free enterprise economic system, even though additional knowledge is accumulated and delivered collectively through the instrumentality of the AAODC, drilling contractors are conducting their individual drilling activities under keenly competitive conditions. Thus the petroleum industry and general public are assured of the highest standard of service at a fair price.

PROGRAM

Program of the ninth annual meeting American Association of Oilwell Drilling Contractors at the Baker Hotel, Dallas, Texas, September 19-21, 1949, is as follows:

Sunday afternoon, September 18. 2-6 p.m. Advance registration on mezzanine.

Monday morning, September 19. 8:30-10 a.m. Registration on mezzanine.

10 a. m., General Session, Crystal Ballroom. J. E. Brantly, presiding. (1) President's address, Joseph S. Morris, Allen and Morris, San Antonio, Texas. (2) "Review and Outlook for the Contractor," Carl Reistle, Jr., Humble Oil and Refining Company, Houston, Texas.

Monday afternoon. 2 p. m. Committee meetings (open to all). (1) Safety, (2) Accounting, (3) Rotary Drilling Equipment and Methods, (4) Research and Educational, (5) Publications, (6) Men and Managements, (7) Cable Tools, (8) Nominating, (9) Resolutions, (10) Dues.

Monday Evening. Continuation of committee meetings where necessary.

Tuesday Morning, September 20. 9:30 a. m. General session, J. E. Warren presiding. (1) Committee reports.

Tuesday Noon. 12:15 Luncheon, Crystal Ballroom, N. H. Wheless presiding. Guest speaker, J. L. Hamon, Cox and Hamon, Dallas, Texas.

2 p. m. General session, A. H. Rowan presiding. (1) "The Balanced Rotary Rig," C. A. Oberg, Standard Oil Company of California, San Francisco, California. (2) "Contractor's Response," Ralph W. Marshall, drilling and Exploration Company, Inc., Los Angeles, California. (3) "Drilling Contract Forms," W. C. Morris, Allen and Morris, San Antonio, Texas, and Hamilton Rogers, Rowan Drilling Company, Fort Worth, Texas. (4) "Operator's Response," Earl A. Brown, Magnolia Petroleum Company, Dallas, Texas.

Wednesday Morning, September 21. 10 a. m. General session, E. C. Brown presiding. (1) "Rig to Office Communications," C. J. Paine, Paine Drilling Company, Dallas, Texas, and Jerry Stover, Communications Consultant, Dallas, Texas. (2) "Diamond Core Bits," R. B. McCloy, Stanolind Oil and Gas Company, Tulsa, Oklahoma. (3) "Hydraulic Power Transmitters," Nicholas A. D'Arcy, Jr., Huntington Park, California.

Wednesday Noon. 12:15—Luncheon, Joseph S. Morris presiding. Installation of new officers.

Wednesday Afternoon. 2 p.m. General session, William T. Payne presiding. (1) Resolutions, Joe Zeppa, Delta Drilling Company, Tyler, Texas. (2) "Selection of Drill Stem," Bruno Schabarum, Carl B. King Drilling Company, Midland, Texas, and Stanley Moore, Drill Collar Service Company, Midland, Texas. (3) Selected Picture.

Wednesday Evening. 7:30 p.m. Banquet, Howard P. Holmes presiding. Toastmaster, Eugene McElvaney, First National Bank, Dallas, Texas. Speaker, Gov. Allan Shivers of Texas.

Entertainment for ladies will include a Neiman-Marcus fashion show at the Mural Room of the Baker Hotel on Tuesday noon, September 20, according to Mrs. Warren S. Churchill, chairman of the ladies entertainment committee.

In addition to the officers shown here Marion S. Church, Dallas, Texas, is general counsel. Permanent directors (past presidents) are: J. E. Brantly, Dallas, Texas; N. H. Wheless, Shreveport, Louisiana; A. H. Rowan, Fort Worth, Texas; Howard P. Holmes, Dallas, Texas; William T. Payne, Oklahoma City; J. E. Warren, Midland, Texas, and E. C. Brown, Long Beach, California.

Directors at large are: Joseph S. Morris; A. W. Thompson; Al Buchanan; Karl L. Kellogg, Long Beach, California; H. L. Rowley; Zach K. Brinkerhoff, Jr., Casper Wyoming; George F. McQueen, Fort Worth; E. E. Pickering, Jr., Houston; K. B. Knox, Houston; John J. Moran, Wichita Falls; H. E. Hamilton, Houston; Warren S. Churchill, Dallas; H. K. Beardmore, Wichita, Kansas; F. W. Brigance, Fort Worth; Frank M. Porter; D. B. Ferguson; R. W. Wire; J. V. Dunbar; C. F. Whaley; Louis A. Beecherl; D. H. Graham, Long Beach; C. J. Paine, Dallas; Will I. Lewis, Mt. Vernon, Illinois; George P. Livermore, Lubbock; C. J. Davidson, Fort Worth; C. W. Alcorn, Houston, and George Lang, Tulsa. * * *

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Heavy Oil Production in Mississippi

THE heavy oil producing fields east of the Mississippi River, in the eastern part of the State of Mississippi and western part of Alabama, appear to follow the northern and eastern limits of the Mississippi Salt Basin.

Fig. 1, a base map of Mississippi, illustrates the geographical distribution of oil and gas fields. The "dotted" and "dashed" lines across the northern portion of the map represent the approximate limits of the Eagle Ford formation and the Lower Tuscaloosa formation (Gulf Series). Sub-surface sands within these formations that occur down-dip from the outcrop and over localized structures yield most of the producible oil and gas in the state. Lenticular sands within the Wilcox group (Eocene), the Navarro group (Gulf Series), and the Austin group (Gulf Series) also yield marketable quantities of oil and gas in certain fields.

Producing Sands

The Heidelberg, Eucutta, and Baxterville fields discussed herein produce entirely from sands within the Austin group, Eagle Ford, and Tuscaloosa formations. Fig. 2 shows the stratigraphic sequence and nomenclature used in the Mississippi area.

There are four main producing sands in the Heidelberg field, namely; Travis, City Bank, Stanley, and Christmas. The Christmas sand is not productive in the Eucatta field; the production comes from three main sands, Travis, City Bank, and Stanley.

All the oils produced from the foregoing sands are asphaltic base and vary in gravity. The Travis sand in West Heidelberg produces oils with gravities (API) from 15.8 to 23.8 compared with 24.3 to 25.3 deg in the East Heidelberg field. The oil from the City Bank sand in Heidelberg approximates 23 compared with 18.5 to 23.6 in the Eucutta field. The same sand in West Eucutta produces oils having gravity of 28.2 to 35.6 deg API. The Stanley sands at Heidelberg produce oil of 20 compared with 21 to 25.1 in the East Eucutta field, while in West Eucutta the gravity of the Stanley sand oil is 34.6 deg API. The Christmas sand in East Heidelberg produces oil whose gravity ranges from 19 to 24.6 compared with a range from 16.7 to 22.7 in the West Heidelberg field. The gravity of the oil produced from the Tuscaloosa sand in East Heidelberg is 24.6 compared with 32.9 deg in West Heidelberg.

The main producing sand in the Baxterville field is the Massive sand of the Lower Tuscaloosa formation. Other producing sands are present in the Lower Tuscaloosa and are called Stringer sands, some having specific names as the Butler, Cooper, etc. The gravities of the oils produced from these sands vary from 12.7 to 18.8 deg API.

Geology

The area that now embraces the Heidelberg field was originally mapped as a surface structure and the location of the discovery well was based on a gravity minimum that was checked by reflection seismograph survey.

The structure of the Heidelberg field is a faulted dome. The structural uplift originated from a deep seated salt movement. Three wells in the Heidelberg field penetrated a portion of the Permian salt mass.

Fig. 3 is a structure map of the Heidelberg field with datum on top of the Stanley sand. Figs. 4 and 5 are West-East structural profiles of the East and West Heidelberg fields respectively.

The location of the discovery well of the Eucutta field was made on the basis of a gravity minimum, which was later checked by reflection and refraction seismograph survey. The original discovery well produced from the Massive sand of the Lower Tuscaloosa formation, but was abandoned after a short period of production due to water encroachment.

Surface structure is evident and can be mapped on the Catahoula

FIG. 1. Map of Mississippi shows oil and gas fields.

FIG. 2. Stratigraphic sequence and nomenclature.

		MISSISSIPPI
GULF SERIES	AUSTIN GROUP	BASAL AUSTIN HEIDELBERG AND EUCUTTA FIELDS (TRAVIS SAND) BAXTERVILLE FIELD (ECTOR CHALK)
		UNCONFORMITY
	TUSCALOOSA GROUP	EAGLE FORD HEIDELBERG SAND AND DARK SHALE SECTION (BELOW THE BASAL AUSTIN TRAVIS SAND) WITH BASAL GRAVELLY SAND
		UNCONFORMITY
		UPPER TUSCALOOSA (GORDO) BASAL "CHICKEN-FEED" GRAVEL
		UNCONFORMITY
		LOWER TUSCALOOSA MARINE SHALE "MASSIVE SAND" WITH GRAVEL LENSES
		UNCONFORMITY
COMANCHE SERIES		DANTZLER FORMATION
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		WASHITA FREDERICKSBURG
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NICKEL-IRON TRAVELING BARREL ROD PUMPS

Many operators prefer the traveling barrel construction for various applications. It is available in the same sizes and plunger arrangements as the stationary barrel type. It can be equipped with double valves and seats, gas anchors and similar accessories.

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The "Oilwell" Tubing Pumps are supplied in many sizes and lengths of one-piece construction. The ends are either regular or reinforced—the latter provides added strength for deep-well service. Available for these pumps are many interchangeable parts, including gas valves, plunger extensions and oversize standing valves. Also, plungers—both pin-end and box-end designs—are available in a wide selection of materials and lengths. The interchangeability of this extensive line of pump parts makes it comparatively simple to adapt working barrels to various pumping conditions.

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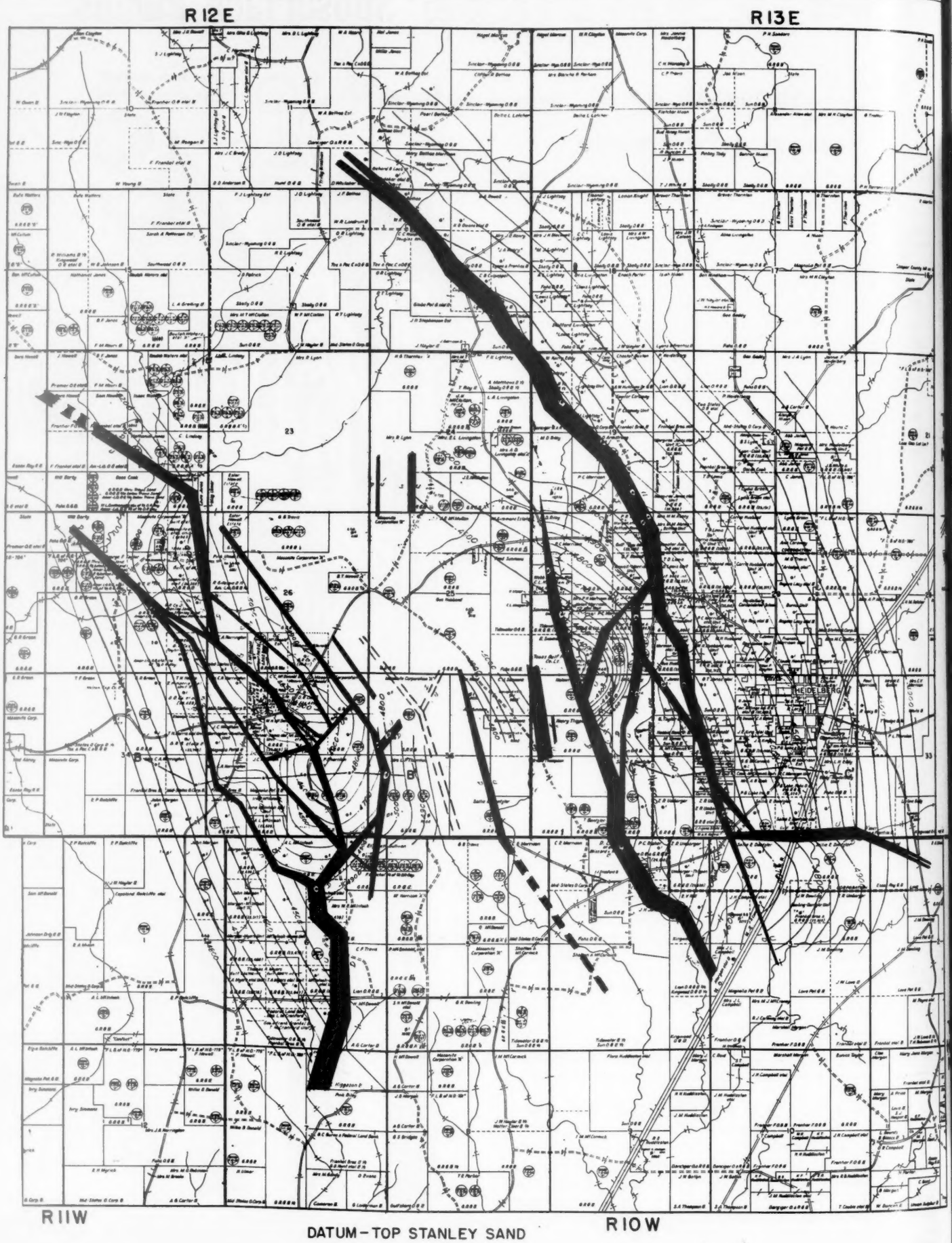

FIG. 3. Structure map of Heidelberg field with datum on top of Stanley sand.

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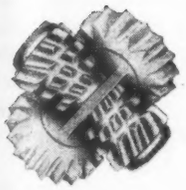

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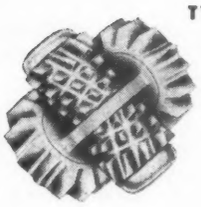

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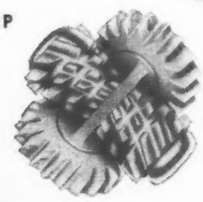

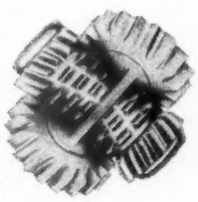

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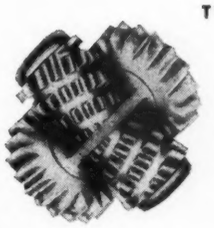

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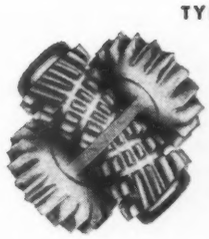

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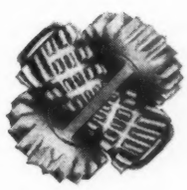

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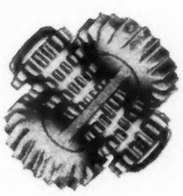

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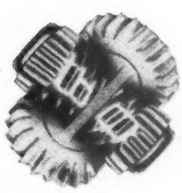

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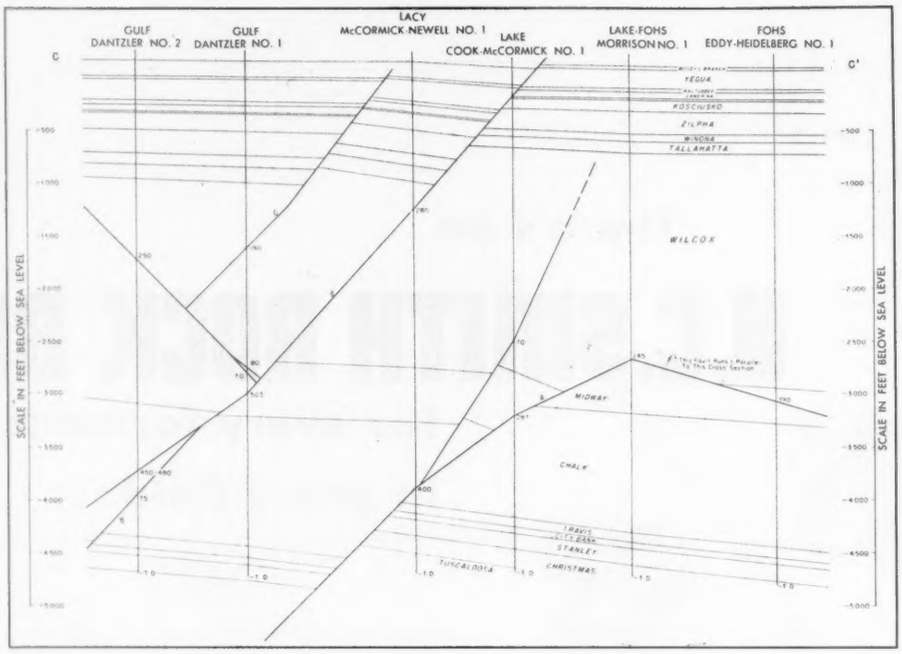


FIG. 4. West-East cross section, East Heidelberg field.

sandstone (Miocene). The structure of the Eucutta field is a highly faulted dome, believed to have originated from deep-seated salt movement.

The location of the discovery well in the Baxterville field was based on a gravity minimum, which was checked by reflection seismograph survey. The discovery well was completed as an oil producer from the Massive sand of the Lower Tuscaloosa formation. An indicated surface structure can be mapped on Citronelle (Pliocene ?) sands and clays that overlie the bluish-green clays and grey siltstones of the Pascagoula and Hattiesburg formations (Miocene). Locally, the Pascagoula and Hattiesburg formations are fossiliferous. The mappable formation is equivalent to the Willis sand of Southeastern Texas and does not include terrace deposits, colluvium, and residuum, erroneously called Citronelle. The structure of the Baxterville field is a faulted dome. A deep-seated salt dome is believed to be the origin of the uplift.

FIG. 5. West-East cross section, West Heidelberg field.

Fig. 6 is a structure map of the Baxterville field with datum on top of the Lower Tuscaloosa.

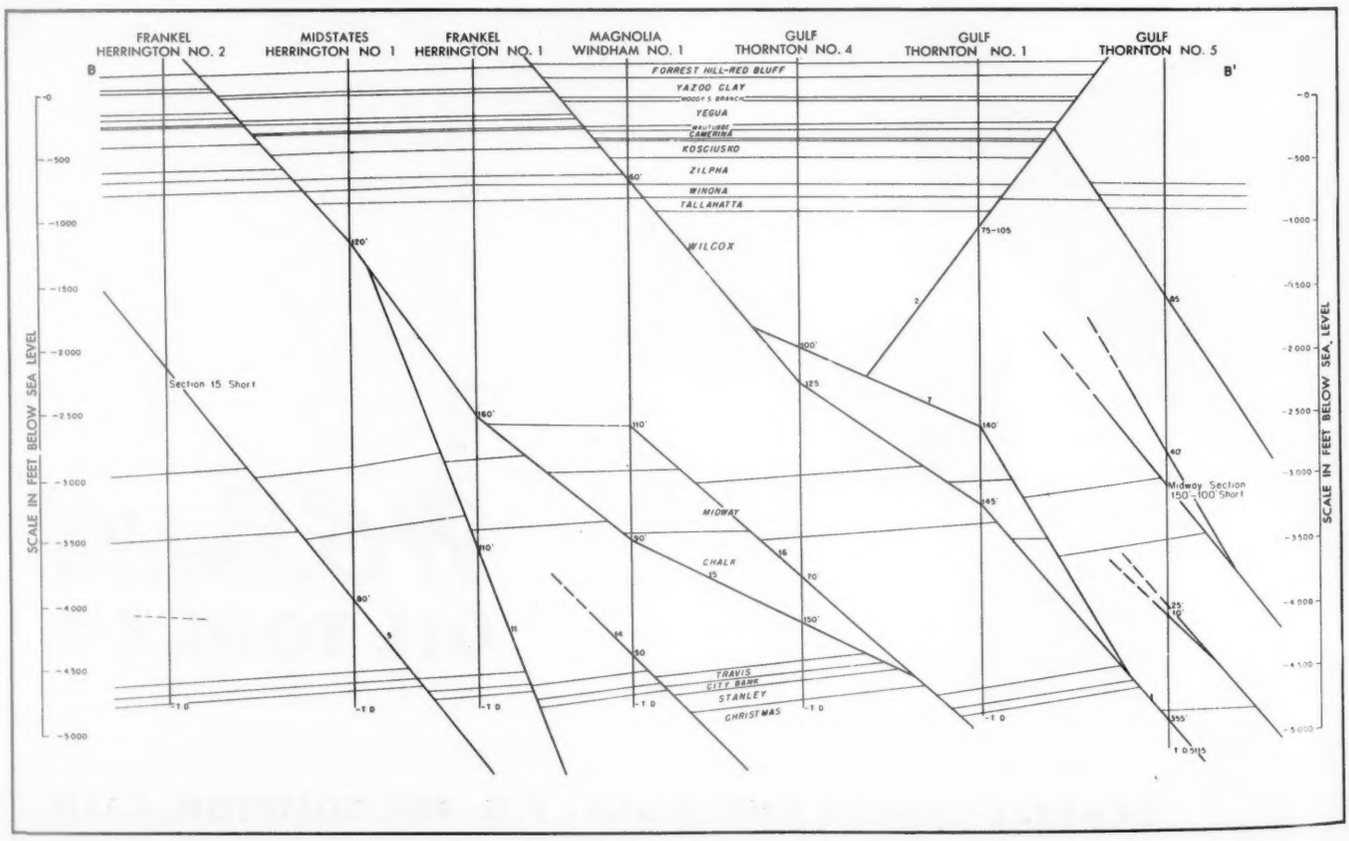
Fig. 7 is a West-East structural profile of the Baxterville field.

It will be noted in the correlation chart, Fig. 2, that the Eagle Ford formation is included in the Tuscaloosa group of Mississippi. In the opinion of many geologists the Eagle Ford is the upper member of the clastic unit that shows a repetition of similar depositional cycles.

Most geologists agree in recognizing unconformities at the base of the Austin and Eagle Ford.

Considerable coring has been the practice in the fields in Mississippi, one of the main factors being the highly faulted conditions. Core analyses of the sands in the heavy oil fields have been of great value in arriving at the most efficient production practices. In addition to the regular analysis data, see Fig. 8, considerable study has been made of the sand grain size, clay content, and sand composition.

In the Baxterville Lower Tuscaloosa reservoirs the sands vary from well sorted medium to fine sands, to poorly sorted very fine sands and



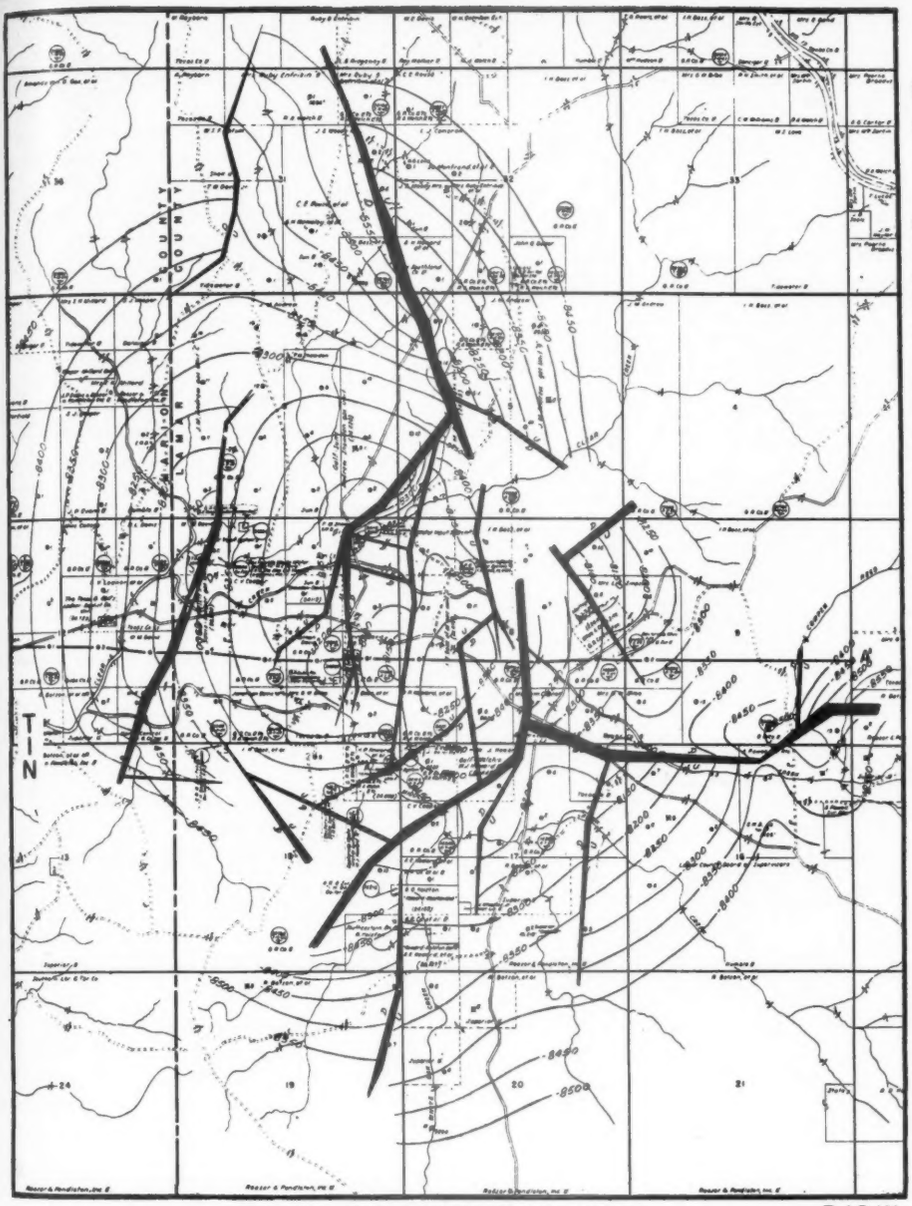


FIG. 6. Structure map of Baxterville field. Datum, Top Lower Tuscaloosa.

silts. The Massive sand, where it is well developed, is normally the best sand and is generally a well sorted fine-grained sandstone with high permeability.

The Stringer sands normally have slightly less porosity and less permeability. In places the Stringer sands approach the Massive sand in porosity, permeability, and water saturation.

Fig. 9 shows the cumulative frequency curves on four fairly representative samples from Baxterville and Heidelberg. The two Baxterville samples are very well sorted fine grained sand with a low percentage of silt and clay sized material. The sorting in the two Heidelberg samples is much poorer and the percentage of clay material much higher.

Salt water and fresh water permeabilities have been run on samples from Baxterville Tuscaloosa sands together with other Tuscaloosa sands in Mississippi and they indicate that there is a decrease in permeability when in contact with water of lower salinity than formation water. The lower the salinity of the water the greater the effect. This action is reversible to some extent, i.e., reversing the procedure using a more saline

FIG 7. West-East cross section, Baxterville field.

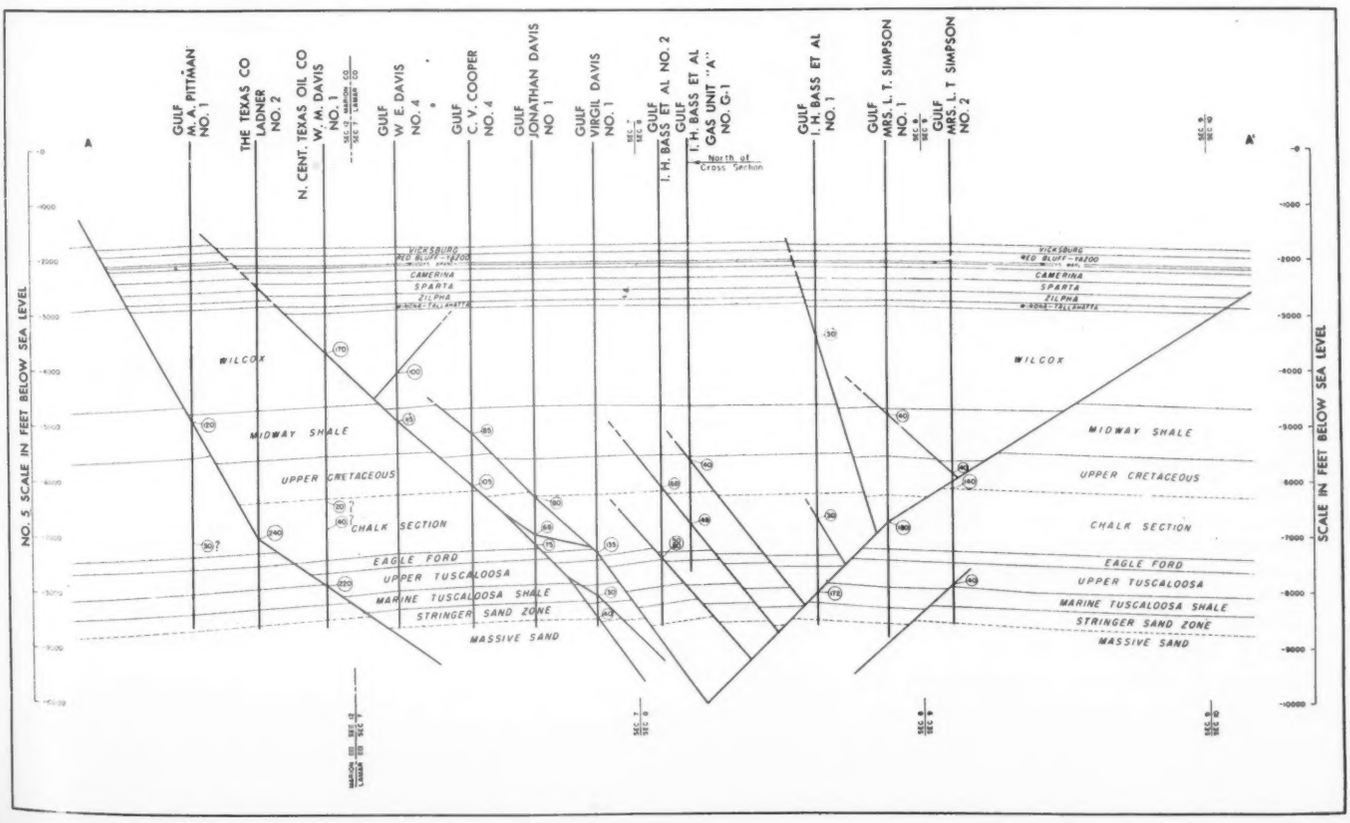

A
A'
GULF M. A. PITTMAN NO. 1
THE TEXAS CO LADNER NO. 2
N. CENT. TEXAS OIL CO W. M. DAVIS NO. 1
GULF W. E. DAVIS NO. 4
GULF C. V. COOPER NO. 4
GULF JONATHAN DAVIS NO. 1
GULF VIRGIL DAVIS NO. 1
GULF I. H. BASS ET AL NO. 2
GULF I. H. BASS ET AL GAS UNIT "A" NO. G-1
GULF I. H. BASS ET AL NO. 1
GULF MRS. L. T. SIMPSON NO. 1
GULF MRS. L. T. SIMPSON NO. 2
North of Cross Section
VICKSBURG
RED BLUFF
CAMERINA
SPARTA
ZILPHA
WILCOX
MIDWAY SHALE
UPPER CRETACEOUS
CHALK SECTION
EAGLE FORD
UPPER TUSCALOOSA
MARINE TUSCALOOSA SHALE
STRINGER SAND ZONE
MASSIVE SAND
NO. 5 SCALE IN FEET BELOW SEA LEVEL
SCALE IN FEET BELOW SEA LEVEL

FIG. 8. General reservoir data.

	Baxterville		Eucutta		Heidelberg	
			East	West	East	West
Gravity of oil, deg API	16		19–23	32	19–26	19–25
Oil-water contact, subsea	8610		4880	4955	4672	4780
Permeability, md.	Sr–660H	400V	T–437		T–288	T–264
	M–1955H	1300V	CB–493	CB–319	CB–389	CB–355
			S–560	S–560	S–1049	S–578
					X–1842	X–1304
Connate water, per cent	Sr–20.04		T–22.0		T–30.3	T–32.0
	M–20.23		CB–43.4	CB–47.0	CB–58.0	CB–42.0
			S–34.3	S–32.0	S–34.0	S–41.0
					X–18.0	X–21.0
Porosity, per cent	Sr–21.1		T–26.5		T–29.4	T–27.5
	M–23.9		CB–30.3	CB–32.5	CB–29.5	CB–25.9
			S–31.6	S–30.1	S–30.2	S–28.6
					X–32.0	X–29.9
Viscosity, centipoises res. press. and res. temp.	10.34		13.0	3.04	8.02	14.88
15 psi and res. temp.	15.64		17.8	4.46	12.34	22.58
Saturation pressure, psi	1110		276	312	873	499
Solution gas ratio, cu ft/bbl	119		51	92	112	74
Formation volume factor	1.0089		1.086	1.078	1.127	1.094
Bottom hole temperature, deg F	229		152	162	151	146
Productivity index, range	0.595 to 43.3		P	P	1.24 to 35.5	P
Salt content of oil, range–lb/1000 bbl oil	156 to 996		I	I	I	I
Chloride content of formation water, range, ppm	206,000 to 227,000		138,500 to 180,000		84,400 to 155,000	84,400 to 155,000

H—Horizntal
V—Vertical
Sr—Stringer
M—Massive
T—Travis
S—Stanley
CB—City Bank
X—Christmas
P—Pumping
I—Insignificant

water will cause an increase in permeability. It was not completely reversible as the original permeability will not be regained. This effect may be caused by bentonitic type clays, which make up a large portion of the clay materials in the formation, or due to a change in sand characteristics caused by a shifting of silt particles.

There is a thick transition zone from 100 per cent water saturation to the "irreducible minimum" water saturation in the reservoir, due to the relatively small difference in specific gravity between the oil phase and the water phase. The thickness of the zone from the point where water is first produced to the point of 100 per cent water production probably is on the order of 8 to 20 ft.

The approach to the water table will generally be indicated by an increase in chloride concentration some 6 to 8 ft above the water table. In the same interval above the water table the cores become spotty with asphalt.

As noted from Fig. 8 there is very little gas in solution, therefore, the reservoir energy is from a water drive, water encroachment or gravity drainage. In the heavy oil fields of Mississippi where the bottom hole energy is dependent upon water movement, a large amount of water will have to be produced to obtain the ultimate oil recovery as the reservoir viscosity relationship of water and oil is approximately 16 to 1.

A group of composite curves showing viscosities at bottom hole conditions for several fields in Mississippi is shown in Fig. 10.

Drilling Practice

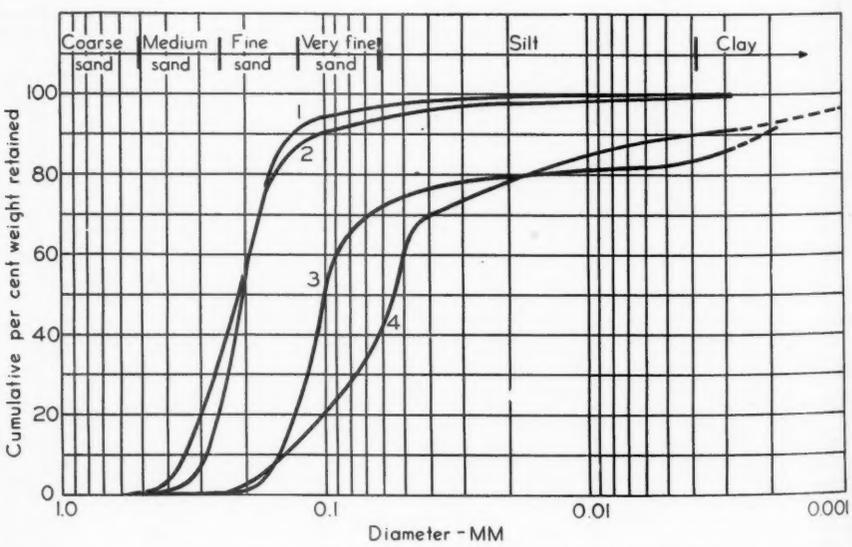
The general practice in the Heidelberg area has been to drill a 15-in. hole to about 1000 ft and set 10¾-in. OD surface casing using 500 sacks of cement. The practice in Baxterville is to set approximately 1600 ft of 10¾-in. OD surface casing. In some of the earlier wells, as much as 2200 ft were used.

Due to the difficulties in segregating oil from water in open hole completions, the practice in Heidelberg, Eucutta, and Baxterville has been to set casing through the producing sands, cement, and then gun perforate. Generally 7-in. casing is used so as to have efficient area that 2.875-in. OD tubing or even 3.50-in. OD tubing could be run as the production string. The size of the bit used in drilling the well below the surface casing is 9.875 in. Coring is done with wire line equipment using a 7.625 core head bit that cuts a 1 11/16-in. diam core, the length of core barrel being 10 ft. The coring program has varied considerably depending on the information desired.

Original completions were made with the well being cored through the oil water contact; recently, all wells generally are drilled to the water-oil contact.

During the early development of these fields a caliper survey was made of the open hole to determine the amount of cement to be used in setting casing. The same is true of the temperature survey, which is used to determine the height of the cement behind the casing.

An electrical well survey is run on all wells from total depth to the bottom of the surface casing. When drilling wildcat wells, surveys are made after penetrating certain known geo-



1. Baxterville, Lower Tuscaloosa, Stringer Sand, R. L. Davis No. 1—Por. 22.3%—Perm. 1880 md.—Fine Sand.

2. Baxterville, Lower Tuscaloosa, Massive Sand, L. T. Simpson No. 4—Por. 23.8%—Perm. 2100 md.—Fine Sand.

3. Heidelberg, Eagle Ford, Stanley Sand, Sallie Dantzler No. 6—Por. 32.2%—Perm. 600 md.—Very Fine Sand.

4. Heidelberg, Eagle Ford, City Bank Sand, Page-Taylor Unit No. 1—Por. 28.4%—Perm. 136 md.—Sandy Silt.

FIG. 9. Cumulative frequency curves on four fairly representative samples.

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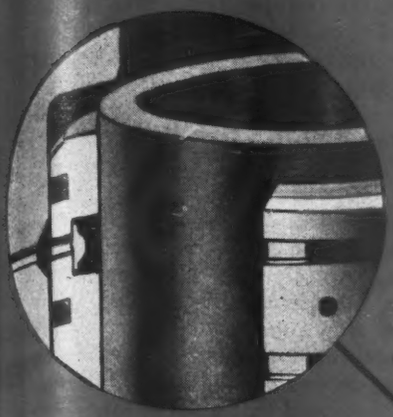
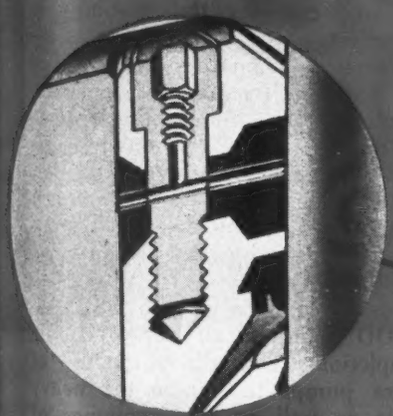
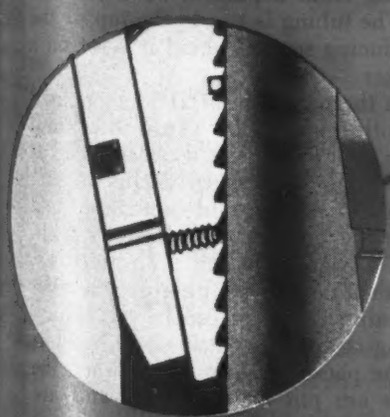


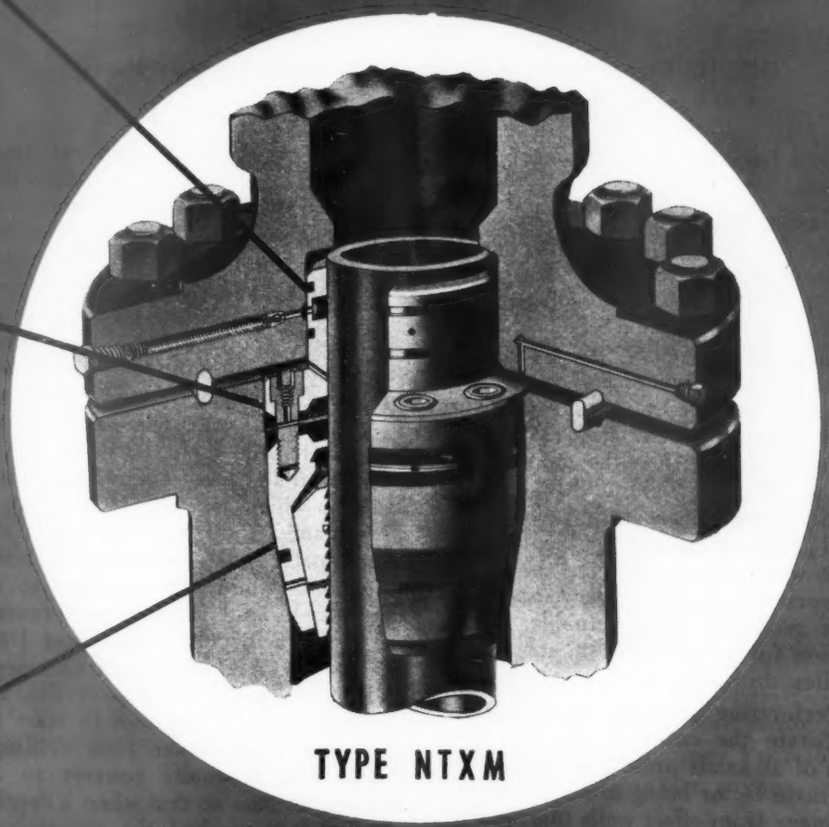
Externally repackable, pre-tested, plastic seal on crossover gland.



Pre-tested resilient seal above slips.



Type "N" slips, with seal ring on slip bowl and lip seal above slips, for temporary but instant seal when setting thru preventers.



TYPE NTXM

Presented above is one of twenty-two interchangeable hanger and seal assemblies for Cameron Forged Steel Casing Heads. This particular assembly combines several proven Cameron casing seals, including the Type "M" seal preparation which has been so widely used in the Cameron Type "M" Test-Weld Flange. This seal may be pressure-tested and repacked at any time during drilling or after the well is completed without disturbing the well head assembly.

The primary casing seal is accomplished by tightening cap screws to expand a resilient seal ring. It may be tested by introducing pressure thru one of the cap screws in which a test port is provided.

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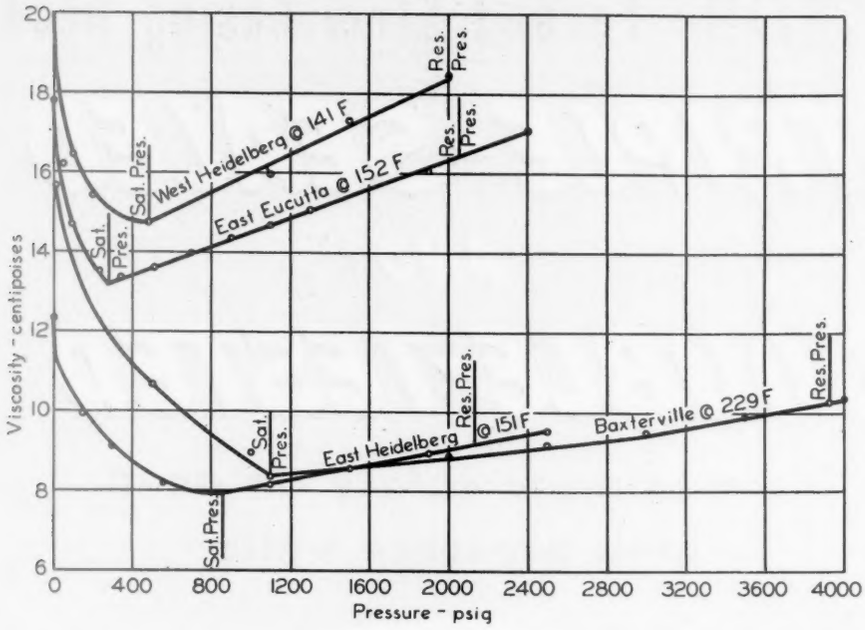

FIG. 10. Composite viscosity curves at reservoir temperatures.

logical horizons to determine coring points.

Gamma-ray radioactive surveys are made on Stringer sand wells in the Baxterville field to locate accurately the thin productive sands for gun perforating. Since neither the electrical log nor the gamma-ray survey indicates the fluid content of gas sands, it might be well to include the neutron survey. The neutron survey can be made at the time the gamma-ray log is run for a slight additional cost. A more active program in radioactive well logging prior to perforating wells would greatly enhance the study of workover procedure as well as provide geologists with valuable information for correlation and structural studies.

Perforating practices have been to perforate the entire producing section of all sands present in the wells; the main factor being to discount any drainage from offset wells that would not be open to production in other wells.

All casing, both 10.75-in. and 7-in., is equipped with scratchers and centralizers. The usual procedure is to space the scratchers 15 ft apart and the centralizers 50 ft apart over the desired area. In Heidelberg and Eucutta, this is about 300 ft above the total depth. In Baxterville, the practice has been to use sufficient scratchers and centralizers to bring them approximately 200 ft above the gas-producing horizon at 7600 to 7800 ft, thus making a total of some 1250 ft of casing equipped with scratchers and centralizers.

All original wells in Mississippi were drilled using conventional fresh water base drilling fluid. After the use of scratchers and centralizers was begun, it was found that almost without exception, returns were lost in the Baxterville field while running or cementing casing. Prior to the use of scratchers and centralizers, returns had been lost on only one or two casing jobs. However, returns had been lost on several wells while drilling in the Baxterville field, usually at a point near the base of the Chalk formation, which is at a depth of approximately 7500 ft. In an effort to overcome this loss of returns, fresh water base mud was changed to a lime-starch mud, which has proved very satisfactory in that almost 100 per cent returns have been obtained on all casing jobs in Baxterville. It is the practice at present to start a well with fresh water base drilling fluid, then gradually convert to a lime-starch base so that when a depth of 4500 ft is reached, the conversion is complete.

In the Baxterville field, 1200 sacks of cement are used in cementing the production casing, normally bringing the top of the cement to approximately 6400 ft, well above the top of the gas producing horizon. In Heidelberg and Eucutta, 500 sacks of cement are used. The usual practice in cementing casing equipped with scratchers and centralizers is to reciprocate the casing after reaching bottom, continuing if possible until the plug is on bottom. A float collar spaced one joint above the float shoe is used on casing jobs.

Because of the steel shortage during the last few years, lighter weight casing had to be used; consequently, in order to use pipe weights available, the collapse factor was reduced to 1⅛-in. selecting casing strings. The improvement in casing cementing practices has proved the reduction in safety factors to be quite satisfactory.

The initial practice in Mississippi has been to run and cement casing through the oil producing horizon and then gun perforate, using 6 ½-in. holes per foot with the conventional type gun-perforating service. However, after the use of scratchers and centralizers was begun, tests were made on wells in the Baxterville field that indicated that wells of lower productivity indices were being obtained. It was thought that the use of scratchers and centralizers cause a more uniform distribution of the cement around the casing, thus resulting in less effective penetrations. One of the perforating companies developed a long barrel gun with more fire power, which was used for a while with no apparent increase in productivity indices. The shaped charge or jet perforating equipment was made available to the oil industry and is now used in Mississippi by some operators.

The practice has been to use 2.875-in. OD tubing in all heavy oil well completions. This allows the use of larger pumps to handle the heavy crude as well as large volumes of water. A combination rod string of ⅞-in. and ¾-in. can be used to handle the heavy loads in 2.875-in. tubing from depths of 6500 to 7000 ft. The tubing is run to the top of the producing section where it is set on a packer.

In the early life of Heidelberg and Eucutta, the wells would flow and were completed with a packer, but as bottom hole pressure declined, subsequent wells would not flow and were put on the pump initially without packers. On all completions, whether flowing or pumping, a seating nipple was placed in the tubing string at approximately 4500 ft. Most of the packers are unseated when the wells are put on the pump and are removed when the first tubing job is required.

Production

In the Baxterville field, the wells are equipped with about 8800 feet of tubing. In placing a well on the pump, a removable slip type combination packer and anchor is attached to the bottom of the pump, which allows the pump to be set at any point in the tubing string. A recent study of the producing fluid levels of the pumping

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wells in the Baxterville field revealed that there are two types of wells; those with an extremely high fluid level above 1500 ft and those with a low fluid level from 3000 to 6000 ft. All pumps were originally set at approximately 5000 ft. Pumps are being changed with a minimum setting of 4500 ft and those that are necessary to set below 4500 ft will be spaced according to the working fluid levels.

A number of the wells in the Heidelberg and Eucutta fields were completed as flowing wells; however, the larger percentage of them had to be pumped upon completion by conventional rod pumps because of the lack of gas for gas-lift. The first type of pump to be used was an insert pump with a 60-in. chrome metal plunger. It has proved so satisfactory in pumping heavy crude that it is now standard equipment in all wells of one large operator. The records show that in many cases, these pumps have been in operation from one to four years without being removed from the well.

At Baxterville, there is sufficient gas available for gas-lift and several wells have been equipped with flow valves; however, most of these have been replaced with conventional rod type pumping units and will be discussed later.

The wellhead surface equipment of flowing wells in the Heidelberg and Eucutta fields consisted of a one-wing unibolt positive choke arrangement. In the Baxterville field higher tubing pressures are encountered and a composite manifold is used until a well is put on artificial lift, at which time the composite manifold is removed.

Surface pumping equipment consists of reduction geared type pumping units most of which are 50 hp with a 74-in. maximum stroke. All pumping units are powered with multiple-cylinder gas engines of a comparable horsepower to the unit.

In the Heidelberg and Eucutta fields several oil and gas separators were installed, but it was found that the gas-oil ratios of 50 to 75 to 1, was too low for satisfactory operation of separators. Two 1000-bbl bolted steel lease storage tanks are used in almost all installations in conjunction with a heater-treater or an oil and gas separator.

In a relatively short time, most of the wells begin to produce BS&W. In order to treat the emulsified oil, a heater-treater is installed, which serves as a gas and oil separator and also automatically separates the free water from the oil, thus separation of the three components—oil, gas, and water — is accomplished with one piece of equipment. At present every well in Heidelberg and Eucutta is produced through a heater-treater.

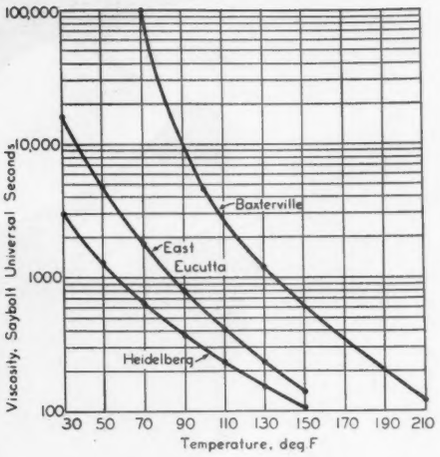

FIG. 11. Composite viscosity curves of stock tank oil.

The situation in Baxterville has proved to be somewhat different for several reasons. Prior to the construction of a pipe line outlet to the Baxterville field by one major company, considerable experimenting was done with reference to the pumpability of the heavy asphaltic crude. Stock tank oil viscosities were taken of crude oil from several different wells. These viscosities cover quite a wide range varying from 1200 Saybolt Universal seconds at 210 F to 100,000 Saybolt Universal seconds at 70 F. (Fig. 11.) The Heidelberg crude was pumpable at 1800 Saybolt Universal seconds and 70 F, but the viscosity of the Baxterville crude being 100,000 Saybolt Universal seconds, it became necessary to heat the crude to 120-140 F to reduce the viscosity of the oil so that it would flow into the suction of the pipe line pump. Originally, 9 boiler stations were installed for heating the heavy crude with steam through coils in the bottom of the lease storage tanks and to supply steam power to reciprocating pumps that transported the oil 14 miles to Lumberton, Mississippi. On the more recent installations, the crude oil is heated in the lease storage tanks by means of an automatically controlled hot water circulating system known as a thermo-syphon system.

In each lease storage tank, there are 6 tiers of upright 2-in. pipe connected at each end with 4-in. headers, which in turn are connected in the center of the tank to a common inlet at the top and outlet at the bottom. The indirect heater in which the water is heated to 190 F is 150 ft from the first tank. The 4-in. inlet line to the tanks is elevated and the 4-in. return line is kept level from the point where it leaves the tanks to the entrance to the heater. In addition, the heater contains 288 ft of 2-in. return tube coils through which the fluid from the well is flowed or pumped for preheating prior to the addition of chemical used in breaking the emulsion before entering the heater-treater. In the case of a pipe-line oil well, the 3-in. coils are used to heat the oil and drive off entrained gas so stock tanks can be gauged correctly, otherwise, as much as 3-ft of foamy oil may be on the top of the fluid in the tanks. On several of the wells where the crude is very viscous, flow line heaters have been installed to reduce the viscosity of the crude so the well will flow to the tank battery. The pipe line pumps on the above type of installation are powered with a multiple-cylinder gas engine.

Other surface equipment associated with the production of the heavy crude oil is that necessary for disposal of the salt water produced with the oil. Closed type systems are used; three of which are presently operating in the Baxterville field. The water is gathered at the disposal plant by gravity flow through asbestos-cement pipe from the respective heater-treaters. The disposal wells are completed in open hole in a salt water-bearing lime section at approximately 2400 ft.

A number of problems have arisen in the production of heavy oil in Mississippi. One of the most important is the types of equipment to be used in lifting the heavy oil to the surface after the well ceases to flow.

In Heidelberg and Eucutta, being comparatively shallow fields (5000 ft), the problem of lifting was not complicated. As there was no gas available for gas-lifting, the rod type pump with geared pumping units was the solution. These have proved very satisfactory. Most of these geared units have a 74-in. maximum stroke and a maximum horsepower rating of 40 and 50 at 20 spm. The API polished rod load ratings are 21,000 and 24,000 lb, respectively. The peak torque ratings at 20 strokes per minute are 228,000 and 320,000 in.-lb. These units were selected because of the anticipated large quantities of fluid to be handled in the future. Several of the wells already are producing large quantities of water. The maximum total fluid production per well has been from 500 to 800 bbl per day. It is expected that such a production of fluid per well will be necessary to deplete the reservoir. Considerable thought has been given

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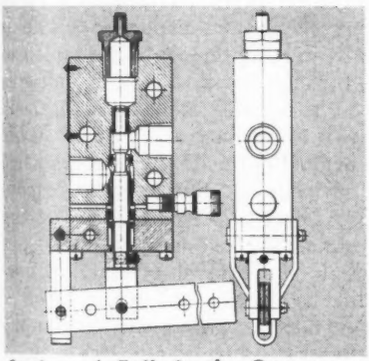
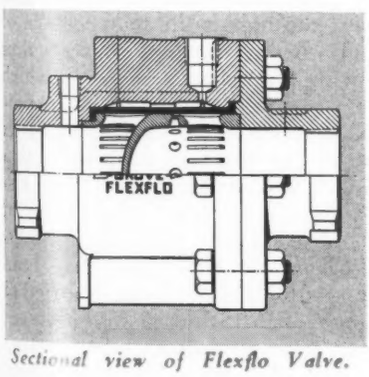


Section of Full Stroke Operator.



Sectional view of Flexflo Valve.

The Grove Model 899 is a combination of the proved Flexflo Valve with a control valve designed especially for direct float-operated separator service. The positive action and dead-tight seal of the Flexflo, together with the lever-operated "Full Stroke" control Valve, gives an ideal non-throttling oil discharge control for any oil-gas separator at pressures up to 1000 p.s.i.

The Full Stroke Control Valve is a 3-way Seat-Seal valve, designed so that one port must close completely before the other opens. No throttling pressure can be applied to the Flexflo jacket . . . the Flexflo will always be either fully open or tightly closed.

On rugged services, handling the most gritty and abrasive fluids, Grove Separator Oil Valves outlast all others and cut maintenance costs to the bone. Wire, write or call your nearest Grove representative today—ask for full information on the Model 899.

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MODEL 899 Separator OIL VALVE

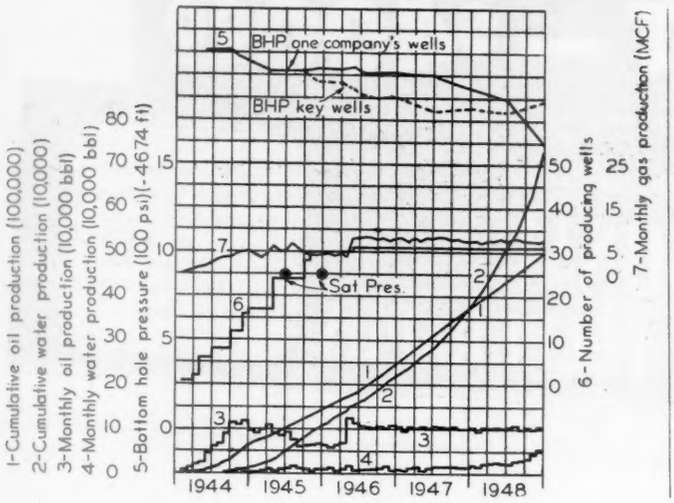


FIG. 12. East Heidelberg field.

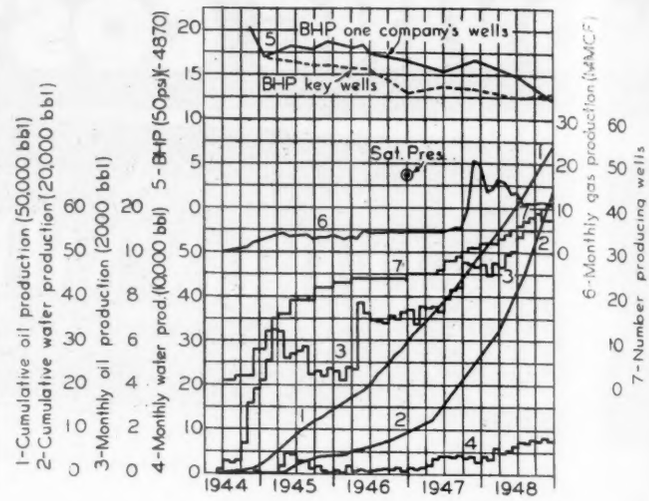


FIG. 13. West Heidelberg field.

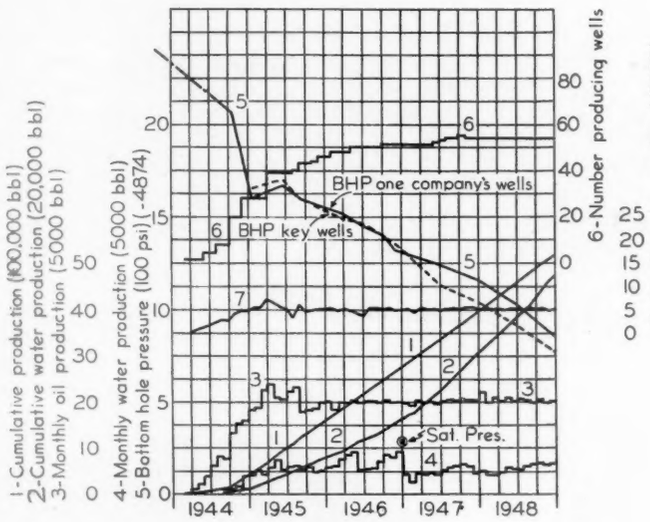


FIG. 14. East Eucutta field.

flow line heaters, a deposit of sodium chloride forms in the flow lines that is precipitated from the extremely heavy salt concentrated water (220,000 parts per million). In several instances it has completely plugged the flow lines.

So long is the time required for settling when heavy oils are being treated that it is of utmost importance the proper size and type of treating equipment be selected. At Baxterville, for instance, a thorough and intensified study was made of the comparative treating efficiency of a conventional gun barrel and an 8 ft by 27½ ft heater-treater. After testing for two months, it was found that the treating cost utilizing a heater-treater was only 45 per cent of the treating cost using a gun barrel. On the basis of this study, heater-treaters were installed on all wells requiring treating. In selecting the size of the treaters, the maximum amount of fluid the treater would

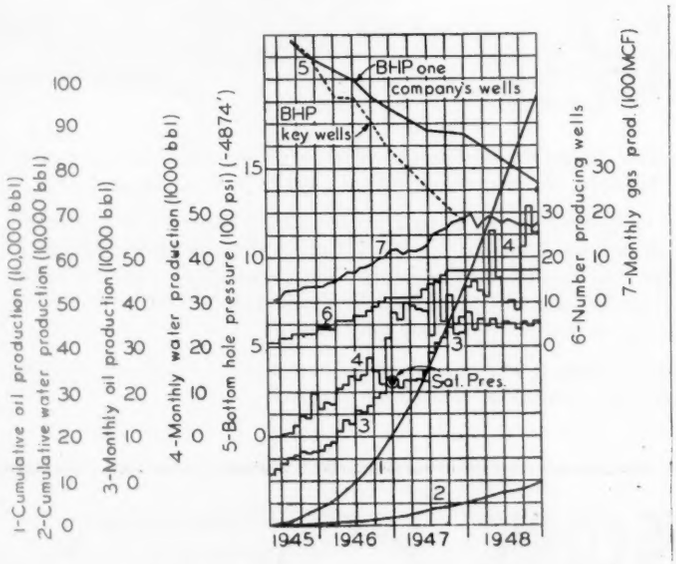


FIG. 15. West Eucutta field.

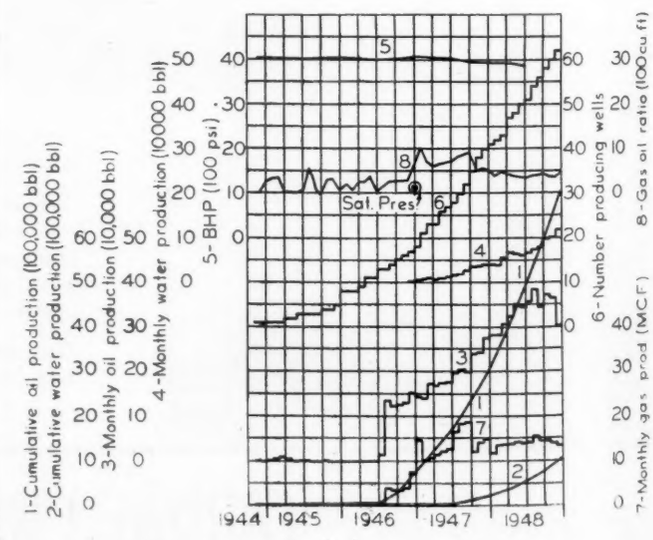
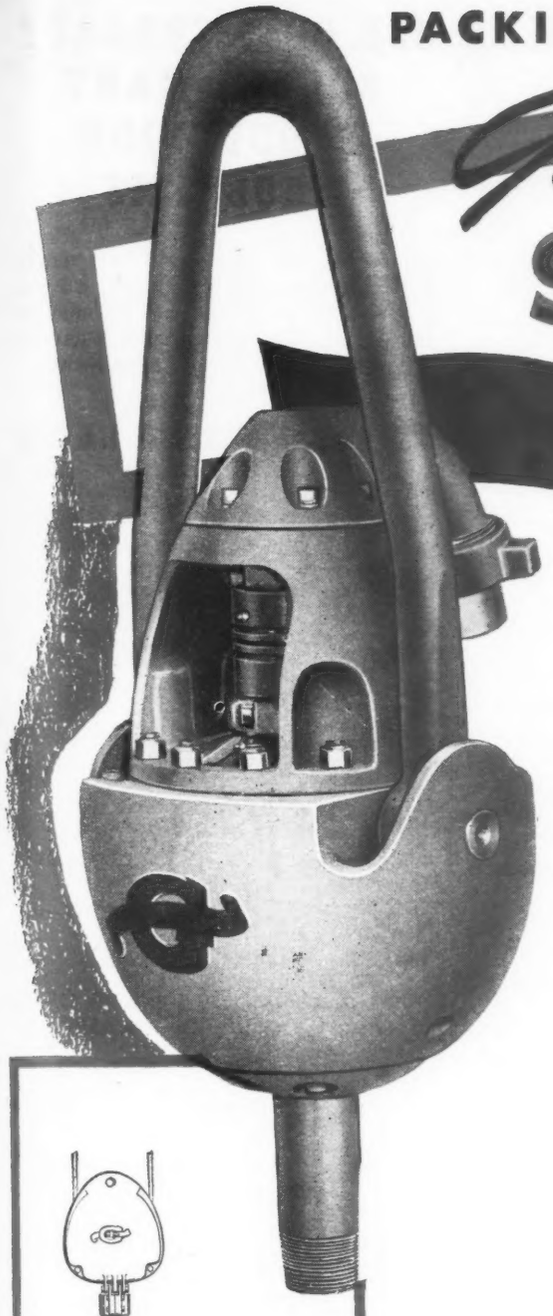


FIG. 16. Baxterville field.

PACKING PROBLEMS REDUCED!

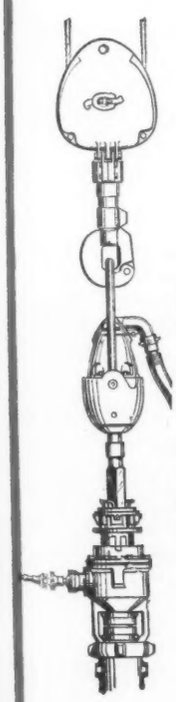
Guiberson 45-TON TYPE "A" SWIVEL

with the FULL-FLOATING WASHPIPE



Your crew will have less down-time with this rugged swivel, because the Guiberson developed full-floating washpipe rotates in two independent packing glands. The unique design of this packing arrangement literally cuts wear on the washpipe in half, because rotation is in either or both packings. Life of packing and washpipe is greatly increased, and when the assembly finally needs replacing it comes out easily and quickly without moving the gooseneck or hose. No special tools are required. Full-sized roller bearings are extra heavy-duty and turn in a circulating oil bath. Extra-large fluid passage is built into the gooseneck, washpipe and spindle.

Gooseneck: 2½" A.P.I. female line pipe thread.
Bottom connection: 3½"-8 thd. left-hand A.P.I. internal upset drill pipe.



The Type "A" 45-ton Swivel completes a unitized drilling string of Guiberson Tools for drilling, work-overs and clean-out work, using reverse circulation. The entire string of Block & Hook, Swivel, Kelly and Drilling Head is ideally suited for short derricks and portable rigs.

See your Guiberson representative for complete information on the Type "A" 45-Ton Swivel and the unitized drilling string

Guiberson U. S. A.

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be expected to handle was taken into consideration and an appropriate size treater was selected having a rated capacity equal to or more than this value. It has since been found, however, that the rated capacity of the treaters is too high for this type of crude. The size of the treaters in operation in the Mississippi fields varies from 4 ft by 27½ ft to 10 ft by 27½ ft, the majority being 6 ft by 27½ ft.

One of the most important problems from an economic viewpoint is treating the heavy crudes. At Heidelberg and Eucutta practically all the oil produced requires treating, while at Baxterville approximately one-half of the oil produced is treated at the present time. At Heidelberg and Eucutta the oil must be treated to 1.5 per cent BS&W, while at Baxterville, the oil must be treated to 1 per cent BS&W, to meet pipe line specifications.

The factors that have contributed to the treating problem are: (1) the small differential between the specific gravity of the oil and that of the water, (2) the high viscosity of the oil, (3) the foamy condition of the oil, (4) the difficulty of obtaining a uniform dispersion of chemical throughout the oil, (5) the unusually high salt content and low pH values of the brine, (6) the formation of a very stable emulsion resulting from the turbulence caused by the well fluid passing through chokes, manifolds, line heaters, and being gas-lifted, and (7) the critical shortage of fuel gas at Heidelberg and Eucutta, which is needed to maintain the high temperatures necessary for treating.

In treating any type of oil emulsions, gravity settling is a very important factor. The rate of settling is usually dependent, among other things, upon the relative specific gravity of the oil and that of the water; that is, the greater the difference in the specific gravity of the oil and that of the water the more rapidly the water settles out, and conversely, the smaller the difference in the specific gravity of the oil and that of the water the slower the water settles out. With heavy crudes, such as those produced in Mississippi, the difference in the specific gravity of the oil and that of the water is approximately .02 to .04 and indicates a very slow rate in the natural gravity settling process. Since the natural gravity settling forces are acting in opposite direction to the normal direction of flow through the treater, it can readily be understood how those gravity forces will be further reduced. After the emulsion has been resolved and the oil allowed to remain in a quiescent state, such as stock tanks, a more complete and rapid separation of fluid into its component parts occurs under these conditions than when the fluid is allowed to move upward in a vertical direction through the treater.

The separation of oil and water by gravity is also influenced by the viscosity of the oil. Oils with a high viscosity are slower in allowing the water to drop out than oils with a lower viscosity. Since the viscosity of the oil is dependent upon temperature, it has been found desirable to maintain treating temperatures around 180 F to obtain best results from this gravity settling principle.

All the heavy crudes produced in Mississippi have shown a decided tendency for part of the oil to remain entrained in the gaseous phase after the gas has broken out of solution. The entrained liquid presents quite a treating problem due to the untreated oil carried by the gas entering the gas equalizing lines in the treater and dropping on top of the treated oil. The foamy condition of the oil has made it necessary to install flow line heaters and steam jacket heaters to preheat the well fluid to 150 F before entering the treater. In some cases the preheat is not sufficient to break down the foam and it is necessary to give the oil a hot water wash by circulating hot salt water into the flow line before entering the treater. The circulating process is accomplished without a pump by merely tying a line from the base of the treater into the flow line. Circulation of the salt water is continuous due to a greater hydrostatic head on the heater than on the riser leading into the treater. Excellent results have been obtained from the use of antifoam agent as a defoaming reagent with concentrations as low as 3 parts per million. The chemical was injected into the flow line as a 2.5 per cent solution with condensate.

Due to the high viscosity of the oil, considerable trouble is experienced in obtaining a uniform dispersion of treating chemical throughout the oil. The location of the point for injecting the chemical is a very important factor, especially in view of the fact that for best treating results, the oil emulsion should be completely resolved by the time the fluid enters the treater. After numerous trials at various points along the flow line, it was found that the best admixture of oil and chemical was obtained by injecting the chemical into the flow line adjacent to the well so as to benefit from the agitation and turbulence caused by the fluid passing through long flow lines, line heaters, manifolds, etc.

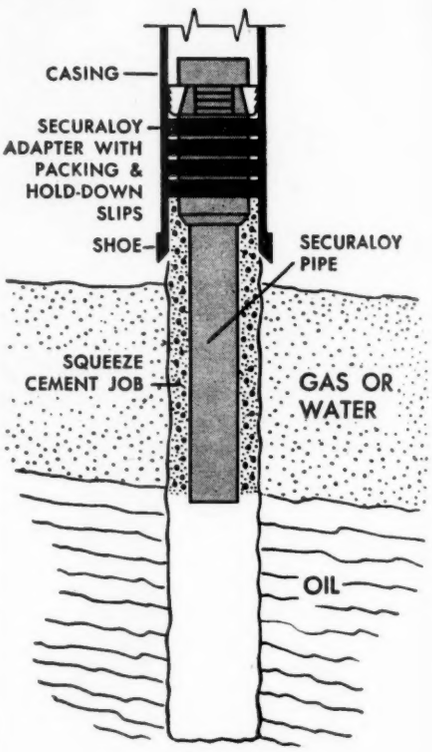
The high salt content of the brine

USE OF SECURALOY SOLVES MANY PRODUCTION PROBLEMS

Securaloy pipe, which may be removed with chemicals or a drilling bit, is being used to solve many "difficult" production problems, such as correcting gas-oil ratios, water shutoffs and plug backs.

CORRECTING GAS-OIL RATIOS

This method is similar to that used in the case history shown on the opposite page except that the Securaloy pipe extends through the gas zone to the top of the oil zone.



Securaloy set on top of producing zone

This method is used where the entire oil zone can be produced from open hole and where it is not necessary to confine the oil production to selective strata. The hole through the oil zone is first filled with gravel. Securaloy pipe is run and squeeze cemented in position. When the cement has set, Securaloy cementing shoe and gravel are cleaned out and well is ready for production, with gas or water successfully under control.

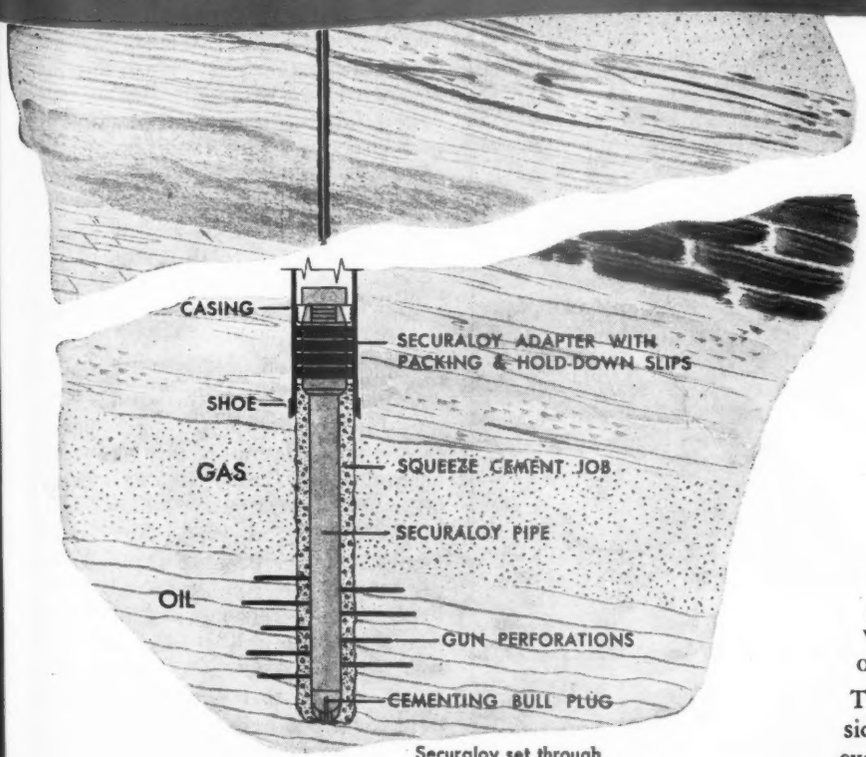
SECURITY ENGINEERING CO., INC.

ONE OF THE DRESSER INDUSTRIES

Main Office and Plant: Whittier, California
Branches in all of the major producing areas
Export Office: Chanin Building, New York City

LOCATION: Texas
GAS-OIL RATIO: 300 to 1
PRODUCTION: 5-6 barrels per day on pump
QUESTION: How to increase production and lower gas-oil ratio by a simple and satisfactory remedial method

Too much gas—Too little oil?



Securaloy set through Producing Zone

When a Texas operator found his gas-oil ratio too high and production way down he determined that the positive way to correct this situation was to use Securaloy. You, too, can profit by using Securaloy to solve your gas-oil ratio problems.

This operator first tried a plastic squeeze job, but the well still made only 6 barrels per day. Then a cement squeeze job was performed, with the entire open hole left full of cement and then drilled out. This proved unsuccessful too!

Finally, the operator cemented Securaloy pipe through the gas-oil sands, as shown. Selective strata were gun perforated and acidized. The well was then completed for 80 barrels of oil per day with a 40 to 1 gas-oil ratio!

This same remedial method is now considered standard practice . . . Another example of the application of Securaloy to solve your production problems.

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at Baxterville has undoubtedly adversely affected the treating efficiency. Studies have shown that the presence of soluble choloride salts serve to increase the interfacial tension relationship between the water and the oil. The salt content of these brines range from 206,000 parts per million to 227,000 parts per million while the pH values range from 4.5 to 5.5. As may be expected in heating brines of this nature, considerable trouble has been encountered from salt deposits in line heaters and on the fire tubes of the treater. In certain cases these deposits build up to a depth of 1 in. on the fire tube and 6 to 8 in. in depth on the baffle immediately below the fire tube. Since considerably less heat is being transferred through that portion of the tube that is encrusted with the deposit, the tube will burn out and collapse from the pressure on the outside. In attempting to reduce or prevent the deposition of the salt, a 6 per cent sodium phosphate glass solution was tried but with only limited success. A laboratory analysis of a sample of the material found adhering to the tube was found to be essentially sodium chloride. Very good results are now being obtained by adding a sufficient amount of fresh water to the treaters so as to lower the salt concentration of the water adjacent to the firebox to approximately 100,000 parts per million.

Almost all the heavy crudes produced in Mississippi are characterized by complete absence of any free water when the total BS&W content is below 60 to 70 per cent. Above these limits, however, the oil may show small amounts of free water. Samples of the oil taken from the wellhead under pressure show it to be emulsified as it comes from the well. It was found that further emulsification occurs by the agitation and turbulence of the well fluid passing at high velocities through chokes, line heaters, manifolds, etc. Tests have shown that most of this second stage emulsification occurs in passing through the chokes where the velocity is greatest. Gas-lifting produces such a stable emulsion that it is impossible to treat the oil except at low rates of production. Another significant fact about these emulsions is that the character of the emulsion changes from well to well so that treating each well is an individual problem. The difference in emulsions from various wells require the use of several different treating compounds to assure the best treating results.

The critical shortage of fuel gas at Heidelberg and Eucutta has presented quite a treating problem, especially during the winter months. This short-

age of fuel gas is more acute at Eucutta than at Heidelberg because of lower gas-oil ratios. At Eucutta, it is frequently necessary to supplement the fuel gas with butane at high cost to maintain the necessary temperatures.

It has already been stated that the heavy crude oil has to be heated to 140 F in the lease storage tank so that it will flow to the suction of the pipe line pump. In addition, one pipe line company has constructed a heating station on the eastern edge of the Baxterville field on the 14-in. main line. The heavy crude is again heated, the oil entering the station at 70 to 80 F and leaving at an average temperature of 170 F reaching the tanks in Lumberton at 68 F.

The station was built when the production from the Baxterville field was reduced to its present volume of 6000 bbl per day. The pipe line's motto is to "never shut down" the movement of oil through the 14-in. line long enough for it to get cold because the pressure required to start the oil moving again would be above the working pressure of the line. When large daily volumes are being delivered through the line, the pump pressures are lower than when small volumes are handled. In the longer gathering lines in the field it requires several hours to move the oil at normal rates after it has been lying in the line for several days. The gathering lines are usually small in diameter and will withstand higher pressures, and many times a pressure of 1300 psi has been attained when starting movement of the oil.

In all fields, considerable technical data such as bottom hole pressures, bottom hole samples, productivity indices, etc., are necessary. As for gathering such data in the Baxterville field, it is the technique of obtaining the data that becomes technical rather than the interpretation of the data.

For example, the first attempt to obtain a bottom hole sample from a well in the Baxterville field was on the C. V. Cooper No. 1 discovery well. The first attempt was made with an Humble 1½-in. OD sampler, which failed to go down through the heavy crude. The second attempt with added weight went to bottom, but no spudding action could be obtained to open the sampler, because the movement was absorbed by the heavy oil. On the third trial, a temperature disc was used but it failed to rupture.

A Phillips Engineering Research Company sampler (1½-in. OD), which is open at the top and bottom and is closed by a spudding action, was tried. A set of 20-in. stroke jars was attached to the top of the sampler but as in the case of the Humble sampler, apparently no spudding effect was had at the sampler as it remained open. However, in order to get it out of the hole, the well was opened on a ¼-in. choke and the sampler flowed out of the hole in addition to hoisting with the wire line unit.

No further attempts were made to obtain a bottom hole sample of this well so samples of the gas and oil were taken on the surface at the separator and shipped to the laboratory for recombination analysis. After the analysis had been studied, a Gulf Stupokoff 1¾-in. OD sampler was used in an effort to secure a bottom hole sample from a well having a much lower viscosity oil. A sample was obtained and this well was sampled again later as a check analysis.

Several bottom hole pressure surveys have been made of the field. The average time necessary to obtain a static bottom hole pressure of a well in the Baxterville field is 6 to 8 hr. The heavy viscous crude will not allow the bomb to descend rapidly. The greatest time required for the gauge to reach bottom in a well to date has been 17 hr. In order to expedite static bottom hole pressure surveys, the general practice is to flow as well as hoist the instrument out of the hole with hoisting unit.

In obtaining productivity indices several hours, four or more, are necessary before the well reaches a state of steady flow. When several rates of flow are made, an entire 24-hr period is used in taking one potential test.

Pressure gauge clocks that will run for long periods of time are necessary. A clock recently developed by one company can be set to the desired number of hours per revolution and will be very helpful. Before the development of the present Gulf Bottom Hole Pressure Recorder, many attempts to get bottom hole pressures were failures because of packing leaks around the stylus piston and joint leaks. It is unusual for recorders to be subjected to high bottom hole temperatures (230 F) for extended periods of time such as are necessary in Baxterville. When failures occur in bottom hole recording instruments, it is necessary to recalibrate. Several calibrations have been made on instruments while running one complete survey of the field.

Producing gas-oil ratios that have been taken on wells are not entirely accurate as the foamy condition of the oil in the separator, when heated, evolves solution gas that is measured, resulting in an incorrect ratio.

One of the first things required when bringing in a new well is its API gravity. It is normal to assume that after a sample is obtained that about ten minutes is all that is necessary to get a true gravity reading. However, obtaining the API gravity of a sample of Baxterville oil taken at the wellhead will consume the major portion of a half day. All the entrained gas will have to be removed, which means that the oil will have to be heated to 160 F and then cooled to 120 F or less before a reading can be made. If the temperature is allowed to become too low the hydrometer will float. Therefore, it is an exacting procedure to obtain an API gravity.

Figs. 12-16 inclusive, graphically present the production history of the Heidelberg, Eucutta, and Baxterville fields. As noted from Figs. 12 and 13, covering East and West Heidelberg, there has been a decided decrease in bottom hole pressures. The Christmas sand in the Heidelberg field has an effective water drive but the upper producing sands of the Eagle Ford and Austin formations have considerably less permeabilities; consequently, the water drive is of the delayed type. The apparent rapid decrease in bottom hole pressure is the result of averaging bottom hole pressure data of all sand since the field is considered one reservoir by perforating each well in all producing sections. Curves 1 and 2 show the cumulative oil and water production of one large operator.

Figs. 14 and 15, covering the Eucutta fields, indicate a very rapid decline in bottom hole pressures. This is explained to a great extent by the Christmas sand not being productive, and to the fact that the producing sands have low permeabilities.

As noted from Fig. 16, the bottom hole pressure in the Baxterville field shows practically no decline, which is indicative of a very effective water drive. The drive appears to be an ideal bottom water type; as vertical and horizontal permeabilities in the Massive sand are about equal. The average well produces approximately 50,000 to 70,000 bbl of pipe line oil before producing water.

The extent of the heavy oil producing area in Baxterville field has not been completely defined, for there remains considerable area on the East side of the field to be prospected.

Experience to date in the heavy oil fields in Mississippi indicate that the flowing life of such fields may be much shorter than the average field producing light oil, and results in the early installation of lifting equipment, before all reservoir and field characteristics are known. Therefore, the question of producing equipment should be studied throughly so that the proper type can be selected. ★ ★ ★

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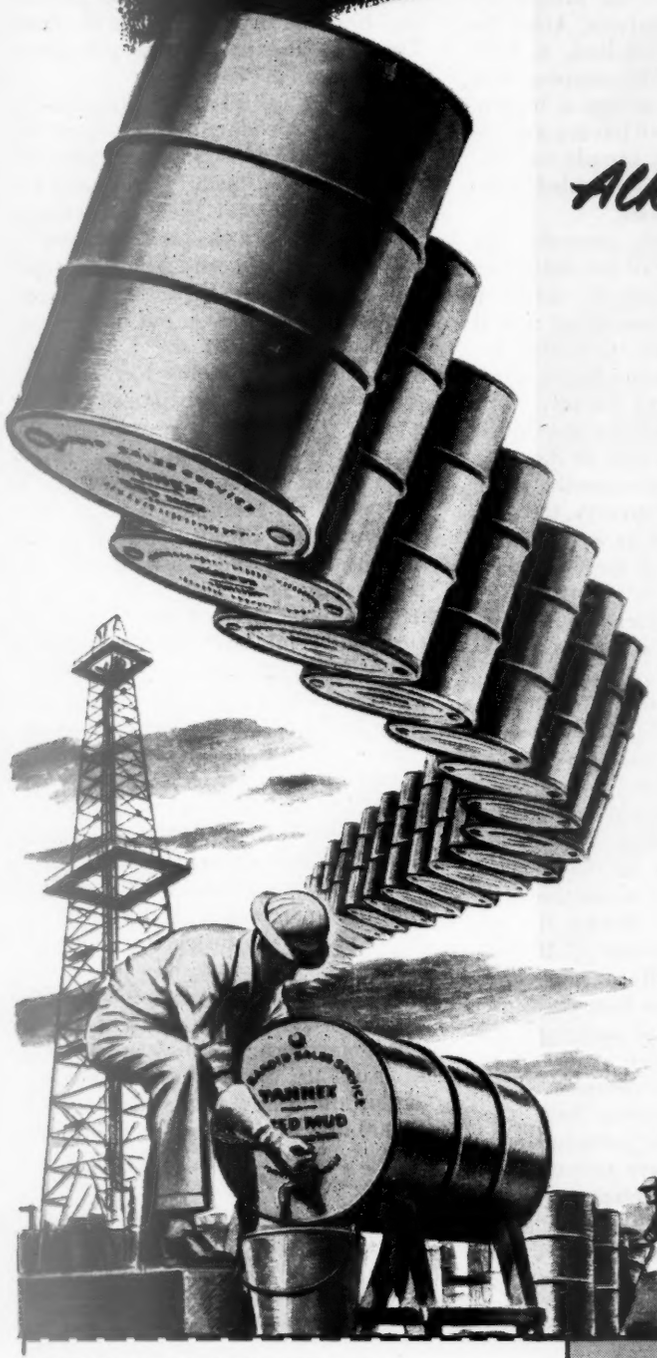

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EXCLUSIVE

Annular Safety Valve

J. M. CLARK*

ALTHOUGH dually completed flowing wells are generally considered to be much more hazardous than single completions, no means of safeguarding dual wells has had wide acceptance. In single completions, subsurface tubing safety valves are used frequently in wells located on or near critical areas such as rivers, lakes, offshore, industrial and townsites. They are also commonly used in wells with excessively high surface pressures or corrosive flow streams, and as protection against sabotage. Dually completed wells certainly need protection under like conditions; in fact, it might be prudent to extend this protection to many others. The serious consequences of casing or well head failures in dual wells should be fairly obvious.

*The Chicago Corporation, Corpus Christi, Texas.

As subsurface safety valves are accepted as the most practical means of protecting single completions, it follows that a similar means should apply to dual wells. For practical purposes, however, a subsurface annulus safety valve should meet several requirements, three of the most important being:

1. Automatic closing at a pre-determined flow rate.
2. Surface controlled opening.
3. Accessibility for inspection or repair.

These basic requirements, which at first glance would seem difficult to attain in a well annulus, are now incorporated in a newly developed tool. This tool, a sub-surface annulus safety valve, was installed recently in a dual gas well, and, through a series of tests, was found adequate to shut in and hold the well annulus under conditions approximating a casing or well head failure. The valve is pressure-differentially-operated, automatically shutting in the annulus when flow exceeds a pre-determined rate. It is opened by repressuring the annulus, and all working parts are installed and removed by wire line.

Valve Tested in Carthage Well

The well selected to test the safety valve was a Chicago Corporation dual gas producer located in the Carthage gas field, Panola County, Texas. The manner in which this well was completed may be of interest as the completion problems were somewhat different than in a conventional dual well. High differential pressures

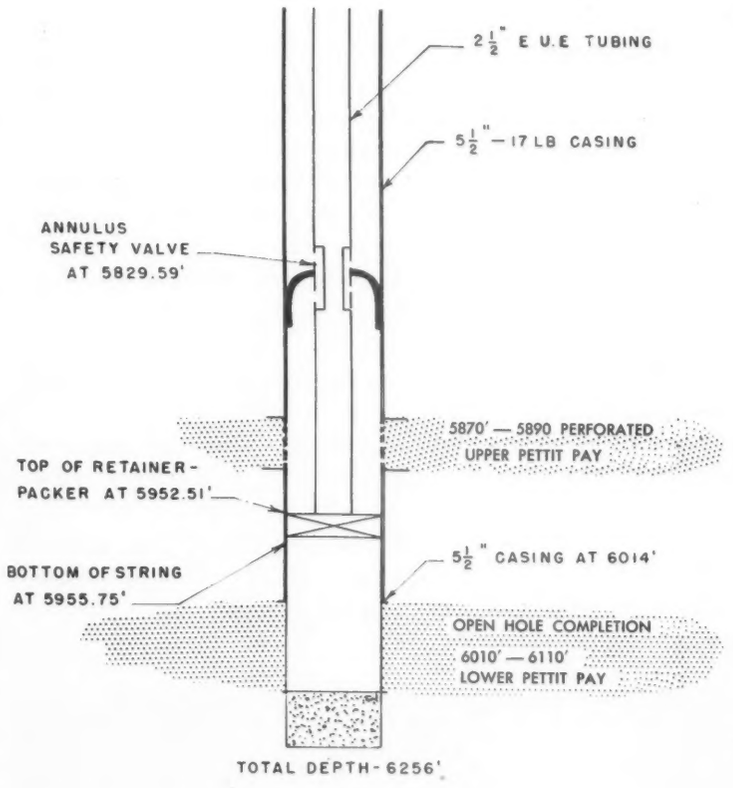
2½" E U.E TUBING
5½" — 17 LB CASING
ANNULUS SAFETY VALVE AT 5829.59'
5870' — 5890 PERFORATED UPPER PETTIT PAY
TOP OF RETAINER-PACKER AT 5952.51'
BOTTOM OF STRING AT 5955.75'
5½" CASING AT 6014'
OPEN HOLE COMPLETION 6010' — 6110' LOWER PETTIT PAY
TOTAL DEPTH-6256'

FIG. 1. Schematic diagram of an annulus safety valve in a dual completion.

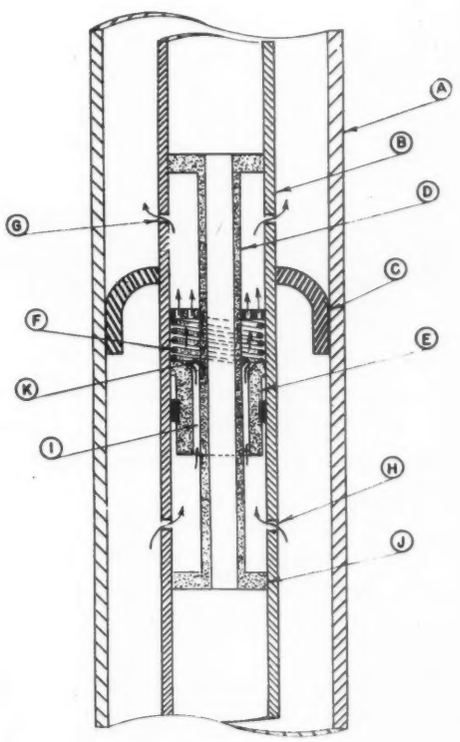

FIG. 2. Cross-sectional diagram of an annulus safety valve installation.

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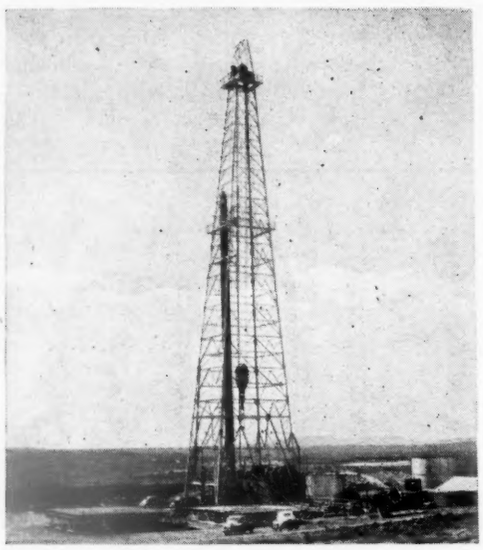

When the "C-19" Casing Head was introduced to the industry more than two years ago, engineering tests had proved that this major advancement in well control equipment was good for long, heavy strings on 20,000' wells.

Now, on The Superior Oil Company's Pacific Creek No. 1, Sublette County, Wyoming, the O-C-T "C-19" . . . a standard head shipped right out of stock . . . has distinguished itself in service at 19,765' on the world's longest, heaviest string of casing, consisting of a combination of 32, 29, 26, 29 and 32 lb. 7" casing.

Suspended weight on this Superior record well was approximately 475,000 pounds by weight indicator reading.

Designed for quick setting and positive sealing, O-C-T "C-19" Casing Heads feature a unitized suspension and seal which greatly simplifies installation, saves rig time, and improves the safety of the completion operation because the well is closed in around the casing before blowout preventers are unflanged.

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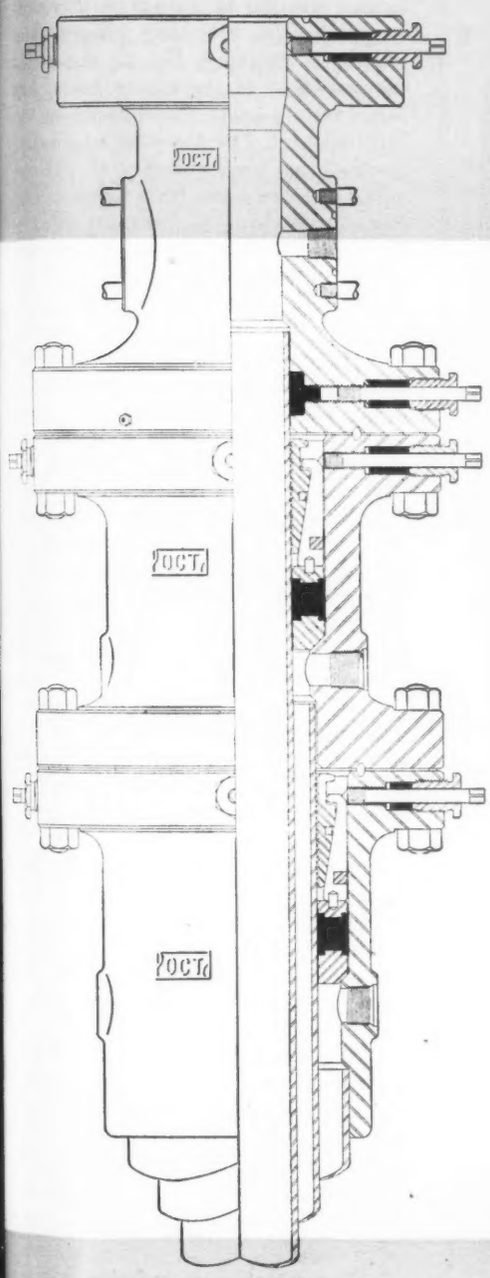
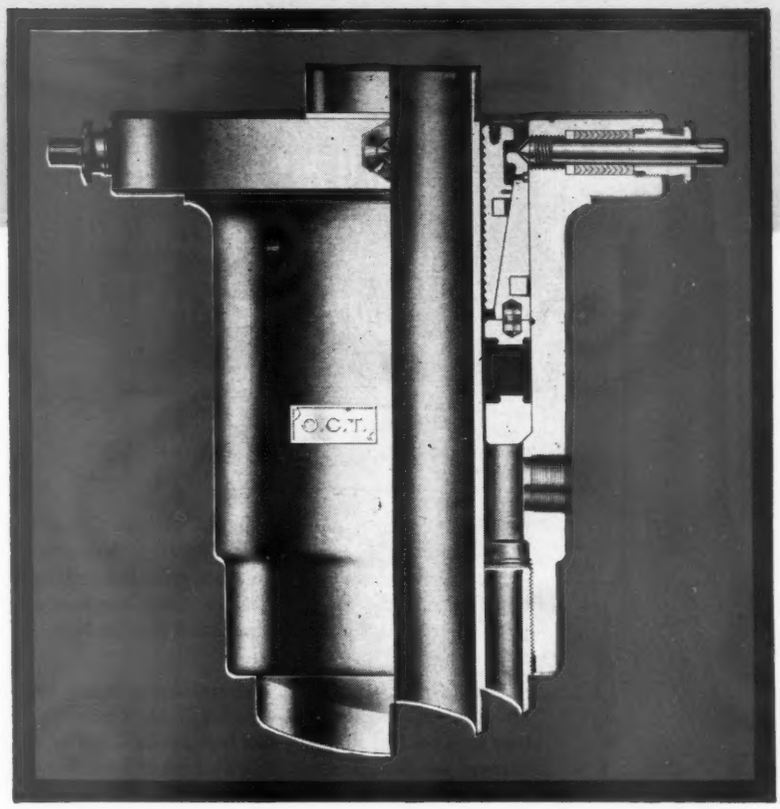


With the O-C-T "C-19" Casing Head as the foundation, this O-C-T wellhead assembly is installed on The Superior Oil Company's world's deepest well. It supports 9,981' of 47 and 53½ lb. 9⅝" casing and 19,765' of 7" casing.



This model O-C-T "C-19" Casing Head was used on The Superior Oil Company's new world's record depth well. It is available in two models . . . C-19 with lock screws or C-19-C without lock screws.

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across the safety valve assembly would tend to lift the tubing string and unseat the lower packer. To prevent this movement, a drillable cement retainer (with back pressure valve removed) was used as a packer to separate the two producing zones. Fig. No. 1 illustrates the setting and spacing of the packer and safety valve assembly in relation to the producing zones.

Washing the well in was accomplished in the same manner as would have been done through a side door choke nipple. As soon as the well was clean, the safety valve was installed in the seating nipple by means of a wire line running tool. Alternate flow tests on tubing and casing showed that the producing zones were separated effectively. The shut in tubing pressure was 2375 psi, and the shut in casing pressure was 2250 psi.

To test the safety valve assembly for strength, the casing was produced at a rate high enough to close the valve, and the flow was continued until the casing pressure had bled off to zero. The pressure was left at zero for a length of time sufficient to demonstrate a complete shut off. To open the valve, the casing was repressured with gas from the tubing.

Valve Closes Automatically

To test the safety valve against its calculated closing volume (5000 MCF per day) the casing flow rate was stepped up periodically until a stabilized rate of 5028 MCF was established. On the next step-up the rate was increased to 5182 MCF. This last flow rate quickly closed the safety valve. It was noted that the valve closed at a flow rate within 4 per cent of its calculated rate. Subsequent tests confirmed that it would continue to close at this rate.

The mechanism used in these tests can best be described as a spring-loaded annular or ring-type valve incorporated in a tubing packer. The schematic drawing, Fig. 2, illustrates the principle of the safety valve, but bears only a faint resemblance to the finished tool. For the sake of clarity, the locking mechanism and various other features have been deleted. The cup type packing, C, prevents upward flow in the annular space between tubing and casing; consequently, all annular flow must enter the ports, H, re-enter the tubing casing annulus pass through the annular valve and through ports G.

The clearance between sleeve E and mandrel D functions as a choke bore and can be varied to determine the flow rate at which the valve will close. When flow reaches the pre-determined rate, pressure differential caused by this restriction lifts sleeve E, forcing it against seat K, thus effecting a shut-off. When pressures are equalized, spring F pushes sleeve E downward, thus reopening valve.

Flow from the lower zone passes through the mandrel D and is not affected by the operation of the annular valve. The mechanism is held in place by the same type locking assembly used on a side door choke. It should be noted that the upper producing zone can be killed without disturbing the safety valve, by pumping down around the cup type packing C. The lower zone can also be killed without removing the annular safety valve.

The safety valve has now been in use for several months and still closes and opens properly. It is the opinion of those who have witnessed these tests that dual wells can now be safeguarded effectively against well head and casing failures. ***

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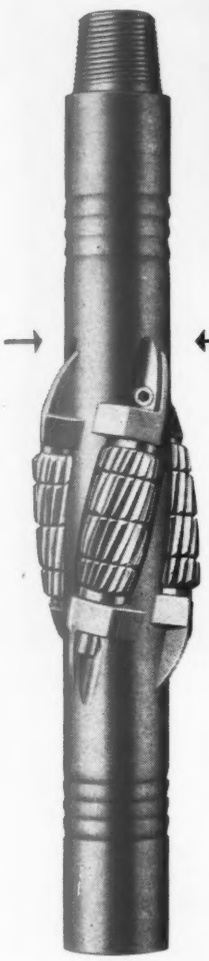

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Production Data on Mississippi Oil Fields

JACK HANCOCK*

In Mississippi, newest of the major oil producing states, almost half of the state's wells produce from below 6000 ft and to as deep as 13,000 ft.

Most of the deeper wells are flowing at present, but the shallow wells—those producing from less than 6000 ft—are nearly all on the pump.

All the so-called "very-deep" production, that from below 10,000 ft, is high gravity crude, 38 to 40 deg API. There are but two fields in the 6000 to 10,000-ft depth range, one producing the highest grade crude in the state, the other the lowest. Most of the production from less than 6000 ft is of 20 to 27 deg gravity.

Although the deepest wells are now producing high grade crude without pumping, it is only a matter of time—and that not too long—until all or most of these deep wells will go on the pump as field pressures drop or water encroachment threatens.

Of Mississippi's 1348 oil wells, 956 are pumping and only 392 flowing, according to the State Gas and Oil Board's latest figures. (Audited to June 1.)

Probably of greater interest is the fact that of 332 wells producing from 10,000 ft or below, 141 are pumping, and all are yielding high gravity crude.

In Brookhaven field (Fig. 1) of Lincoln county, for instance, there are 150 wells producing from below 10,000 ft, and 98 of them are pumping. The average gravity of the oil is 38 deg. More than 60 wells have been equipped for hydraulic pumping and in most of these the pumps are set at depths greater than 10,000 ft. making this the largest deep-pumping project in the world.

Of the other "very deep" production, 100 wells are in Mallalieu field (Fig. 2), also in Lincoln county, and not far from Brookhaven field. Of the 100 wells, 40 are on the pump. The average gravity of the Mallalieu crude is 39 deg.

In the Cranfield field, (Fig. 3) 79 wells produce from the Lower Tuscaloosa formation, below 10,000 ft, and all yield 39 gravity crude; only one is on the pump.

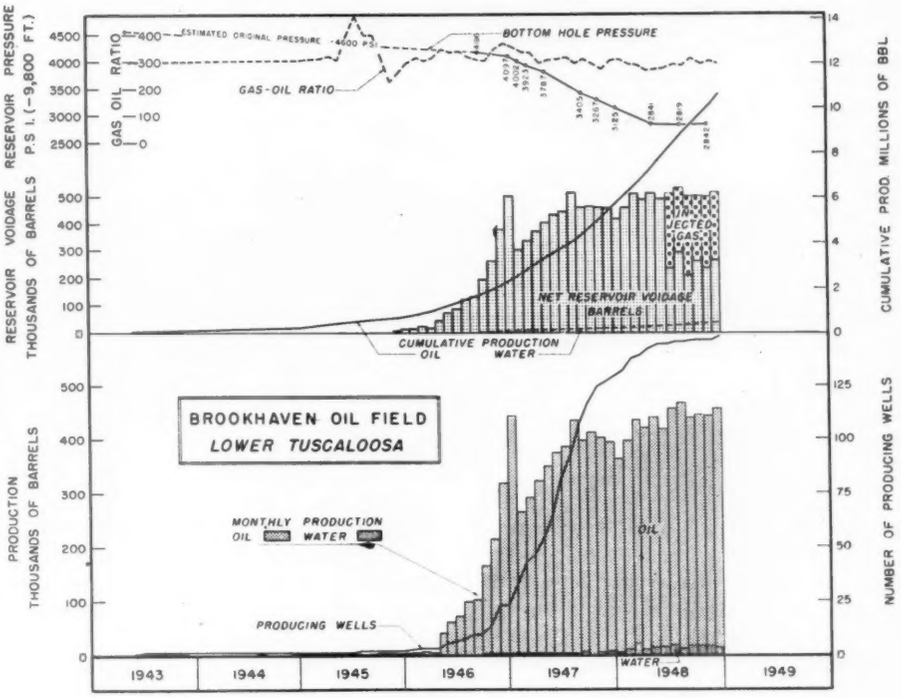


FIG. 1.

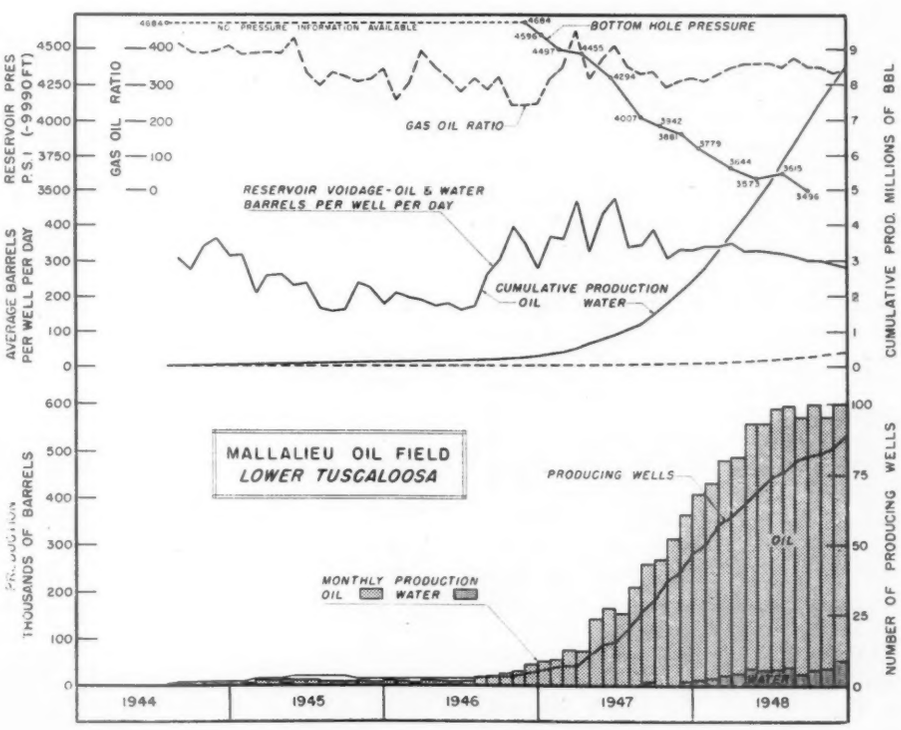


FIG. 2.

*Oil Editor, *Jackson Daily News*.

Graphs are by courtesy
State Oil and Gas Board

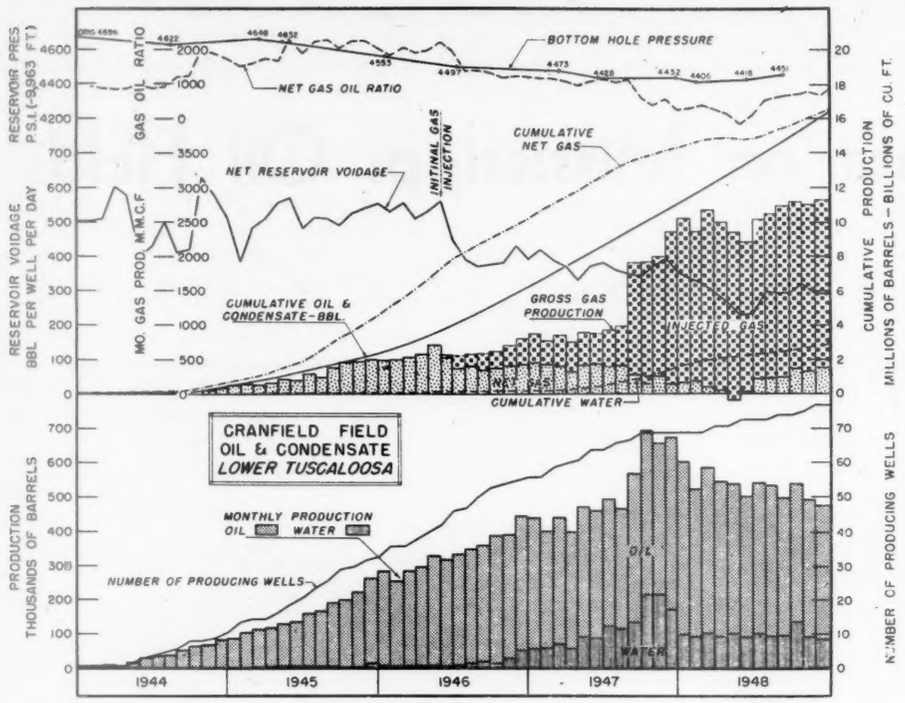


FIG. 3.

whose 100 wells produce crude of 39 gravity, average, the first recorded bottom hole pressure (late 1946) was 4684 psi, but with uncontrolled production this dropped steadily until on June 1 of this year the pressure was 2865 psi. Disturbed by this drop in pressure, the State Oil and Gas Board after an open hearing, set an allowable of 200 bbl per day per well for a 90-day "test period."

If allowables are set in Mallalieu, it will be the first oil field in Mississippi for which the board will have set allowables; for many months, allowables have been set for the Gwinville gas field and for gas production in several minor pools.

Allowables, as such, have not been attempted, however, for any of the state's oil pools; but temporary maximum daily production rates have been set in four other fields, pending "full dress" hearings by the board on proposals to set allowables in each.

In LaGrange field of Adams county, for instance, where the original BHP was 2703 psi, according to the records of the state oil and gas board, the pressure had dropped to 1900 psi when on July 1 the board set a maximum of 100 bbl per day per well.

South LaGrange, still classed as a separate field, had a BHP of 2637 when the pool was discovered in Oc-

There are only three other wells producing from below 10,000 ft; two in the Oldenburg field of Franklin county, where the crude is of 38 gravity and where one well is on the pump. The other is the state's deepest producing well—the lone producer in the Ovett field of Jones county, yielding 31 gravity crude from 13,000 ft. It is on a beam type pump.

The only field where wells are in the 8000 to 10,000-ft depth range is Baxterville, (Fig. 4) where 124 wells produce crude of an average gravity of 17 deg. Of the 124 wells, 49 are on the pump. Baxterville field is in Lamar and Marion counties.

The only production in the 6000 to 8000-ft depth range in Mississippi is from the LaGrange field (Fig. 5) of Adams county, including the South LaGrange area. There are 118 wells, producing oil of 40 gravity—highest gravity oil in the state. Of the 118 producers, 77 are pumping.

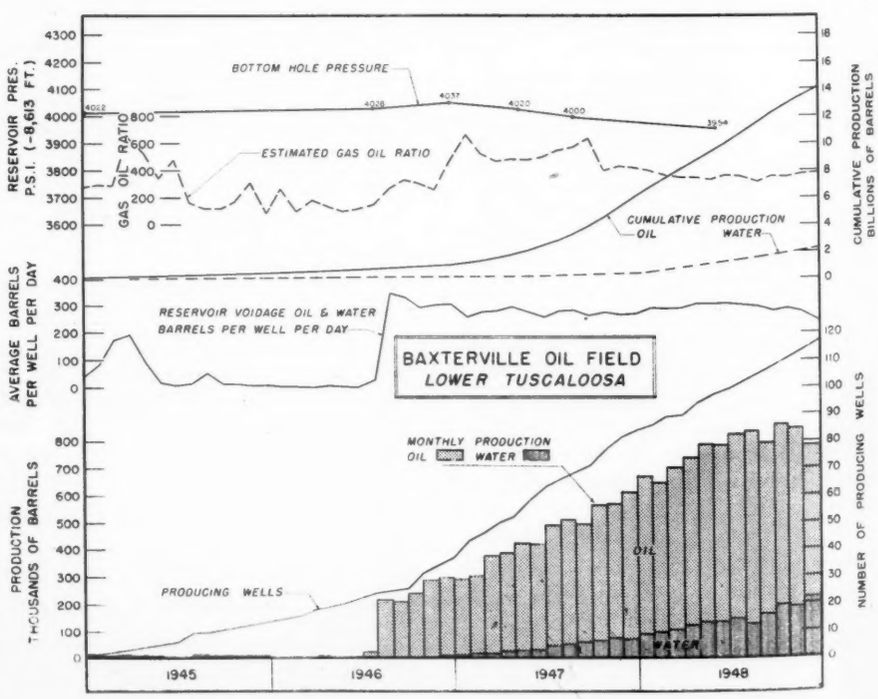
Thus there are 774 wells in the state producing from less than 6000 ft and of them, 689 are on the pump.

There remain only 85 of the state's "shallow" wells (those less than 6000 ft deep) as flowing wells; a considerable difference from the deeper wells, 307 of which are flowing and only 267 pumping out of the total of 574 wells producing from deeper than 6000 ft.

Of the 689 pumping wells less than 6000 ft deep, 282 are in Tinsley field of Yazoo county, the state's original oil strike. Heidelberg field in Jasper county has 147 wells, all pumping; Eucutta in Wayne county has 123 wells, all pumping; Yellow Creek field in Wayne county has 51 wells, all pumping; all the 43 wells in Pickens field of Madison and Yazoo counties, are on the pump and the 33 wells in Langsdale field of Clarke county are all on the pump.

In Mallalieu field in Lincoln county,

FIG. 4.



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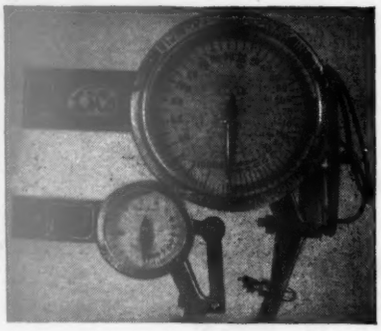

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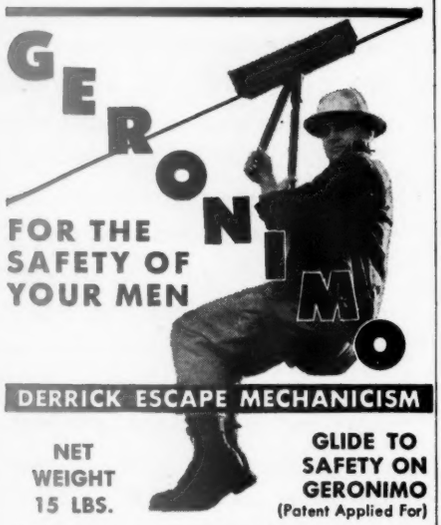

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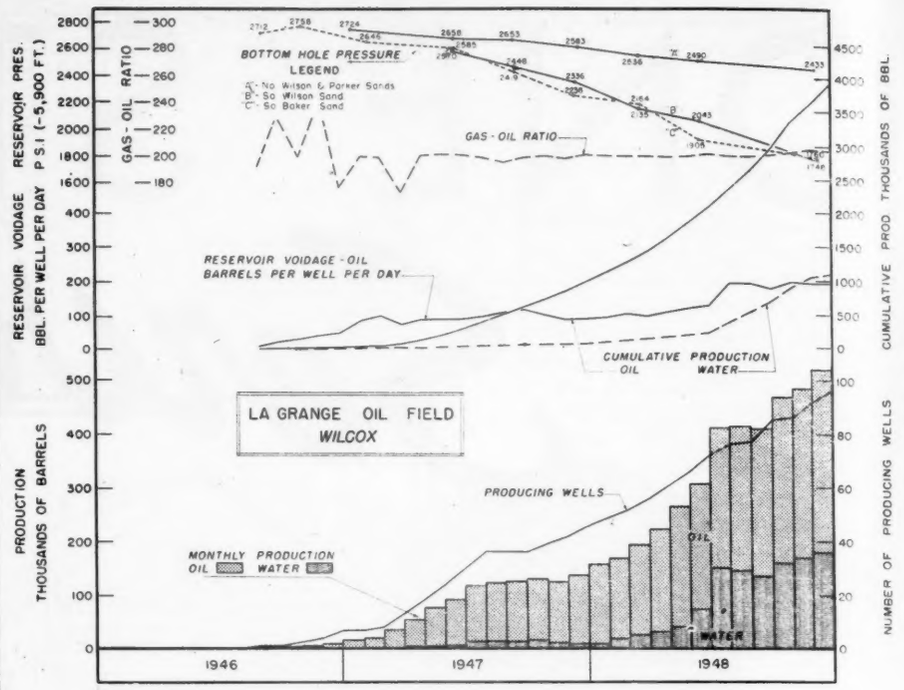

FIG. 5.

tober, 1948, but the pressure decline was so rapid that when it reached 2560 psi the board also set a maximum of 150 bbl per well per day, pending a hearing on allowables August 1.

In Pine Ridge field, also in Adams county, the original reservoir pressure was 2493 psi. After producing in excess of 2½ years, the reservoir pressure was 2358 psi. The Board engineers made a study of this field, and then approved a recommended 125 bbl of oil per well per 40-acre producing unit per day as the maximum efficient rate of production for the field. This is the only Wilcox field in the state in which wells completed during the early part of field development are still flowing.

In the Lower Tuscaloosa oil pool of the Hub field in Marion county the original reservoir pressure was 4226 psi. After producing for a period of 2½ years, the reservoir pressure was approximately 4178 psi and the Board ordered the production in the Hub oil field to be restricted to 100 bbl per 40-acre drilling unit per day, provided that wells with gas-oil ratios in excess of 2000 to 1 restrict their production so that the daily gas production per 40-acre unit would not exceed 200,000 cu ft.

The Baxterville oil and gas pools in Lamar and Marion counties may also have an allowable set before this appears in print. The Baxterville gas field is divided into producing units of 320 acres; production is from the Eutaw-Upper Tuscaloosa formations. The Baxterville oil field is divided into producing units of approximately 40 acres; oil production is from the Lower Tuscaloosa formation.

At Tinsley field, the state's original strike, no complete figures on reservoir pressure are available, as the state operated under a different setup at the time the field was discovered. Every well in that field is now on the pump. The lack of reliable reservoir pressure data is due in part to the fact that there are six producing sands in this field. The reservoir pressure in the entire field is slowly declining, but the rate of decline is slow.

In the Heidelberg field, the last available complete figures on water-oil ratios are for May; they show total oil production of 224,818 bbl and total water of 164,639, a ratio of water to oil of .732. The gas oil ratio is 157 cu ft per bbl.

The LaGrange field in May produced 427,063 bbl oil and 253,030 bbl water, a ratio of water to oil of .592, including both the LaGrange and South LaGrange units. The gas oil ratio there is 200 cu ft per bbl (200 to 1).

The Mallalieu field produced during May 562,189 bbl oil and 91,251 bbl water, a ratio of water to oil of .162. The gas oil ratio was 396 cu ft per bbl.

The Brookhaven field oil production for May was 457,363 bbl oil and 24,574 bbl water, a ratio of water to oil of .053. ★ ★ ★

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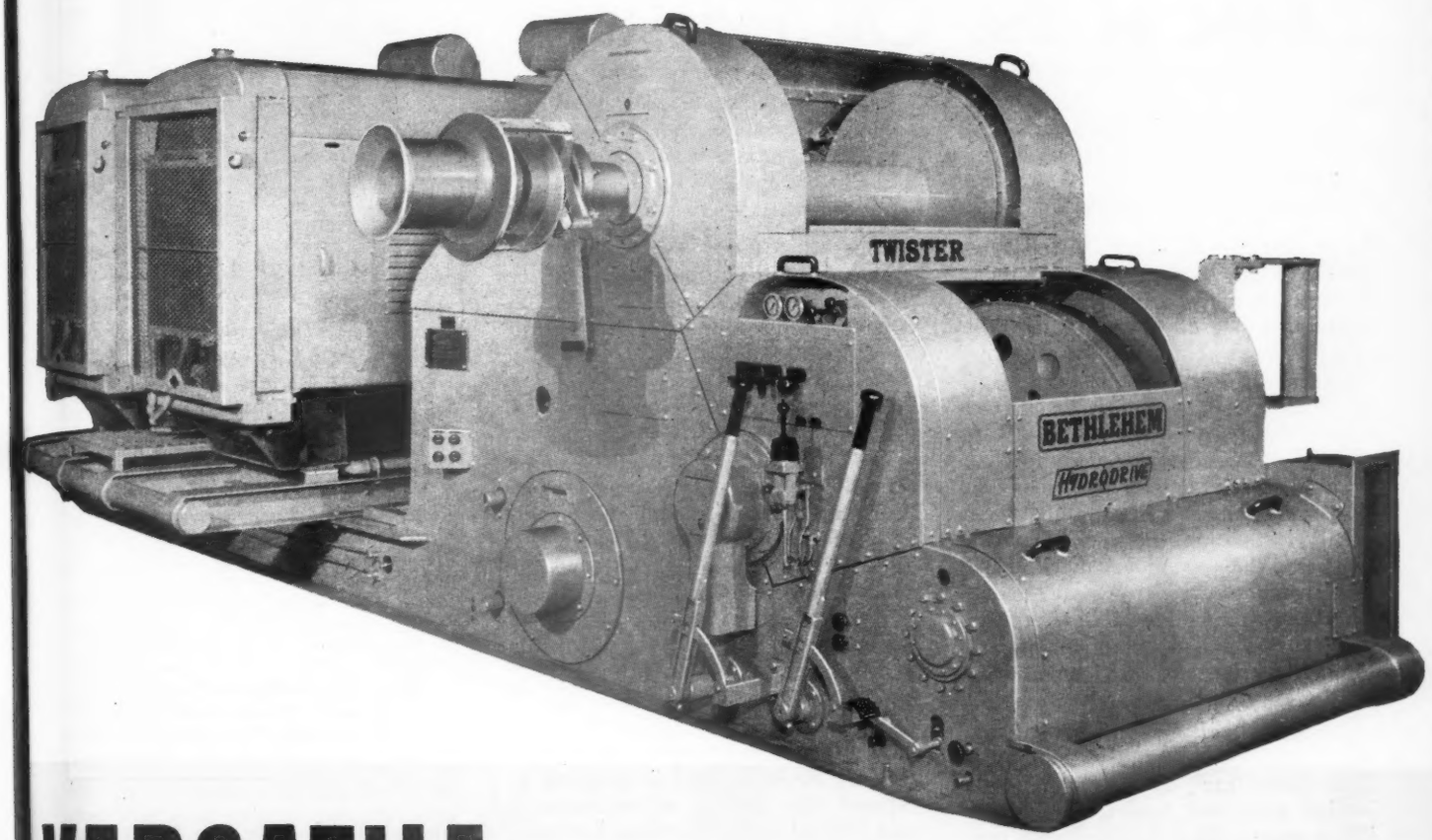

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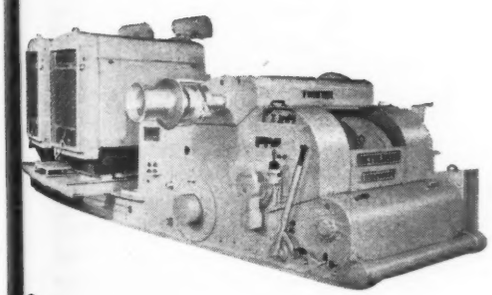

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The Drilling Contractor's Role in the Oil Industry

J. E. BRANTLY

The Author

J. E. Brantly was first AAODC president, 1941, and 1942, and is chairman of the program committee for the meeting this month. A native of Georgia, he studied geology and mining engineering at the University of Alabama, where he became an instructor. He became in turn, state geologist of Georgia, a consulting geologist and chief geologist of the Atlantic Refining Company. In 1929 he organized and has since been president of Drilling and Exploration Company, Inc., Dallas, Texas, and Los Angeles, California. In addition to activities in the United States, he has engaged in extensive operations in Colombia, Venezuela, Trinidad, Canada, Peru, and Brazil.

It is said that the first oil well completed by Col. Drake near Titusville in 1859 was actually drilled for him by a contractor. We do not know the type of contract used but doubtless it was a "cost plus" or day work agreement, more likely the latter, for certainly at that early day and on this first well the usual footage contract would have been quite impractical. It is also said that immediately following the completion of this well the work of boring holes into the ground was done almost entirely by contractors, who at the time were more correctly blacksmiths, and their helpers who built their tools on hand forges that were located at or near the site of the wells.

Then the tools were of the percussion type, crude, manually operated. With their "rag" lines they could be loaded into and hauled by a one-horse wagon. The cost probably represented little more than a few hundred dollars for each rig. Such tools continued to be used for many years thereafter. The contractor's financial requirements were negligible.

Today it is a different story. The heaviest internal combustion engine-driven rotary rig with its accessory machinery and equipment may weigh 1000 tons and cost almost (U. S.) $1,000,000. Probably many years had elapsed after the first well was drilled before all the rigs owned by all the contractors or even the entire industry reached this figure.

Contractors Accept Responsibility

The contractor in the early days drilled a few hundred feet at most and was merely a workman by the day. Now he drills holes 14,000 to 15,000 ft deep for a footage fee and accepts all the mechanical responsibilities for the job. Maybe it is unfair to the contractor that he should have to accept such responsibilities at such hazardous depths when he has no share in the production of the well—but he does accept them and can do so only because of the vast improvements in equipment used and in drilling practices in quite recent years. These improvements are still being made.

The oil well drilling organizations in operation today own modern or usable drilling equipment and facilities that have cost about (U. S.) $500,000,000. This equipment consists of some 3000 rotary drilling rigs of various vintages and types and an equal or larger number of cable tool rigs. These organizations drill 30,000 wells, more or less, annually at an approximate overall cost, including permanent surface and subsurface well equipment, of (U. S.) $1,000,000,000. The intangible drilling expense, or that for which the drilling contractors and oil company drilling departments are directly responsible, is about two-thirds of this sum, or let us say, (U. S.) $650,000,000.

Thus with a producing rate of 2,000,000,000 bbl annually the sum of (U. S.) $0.50 per bbl is required to support the drilling of exploratory and oil field wells. This does not mean necessarily that the cost per barrel of oil produced for the account of drilling is fifty cents, it may be more or it may be less, but it does mean that under present operations that much money must be taken from the sum for which each bbl of oil is sold in order to replace that bbl of oil, or that sufficient wells may be drilled to maintain our reserves and production.

Gas wells are included with oil wells in these figures which are intended to indicate the magnitude of the business of drilling oil and gas wells rather than to give accurate statistical data on the industry.

Contractors Own Most Rigs

Drilling contractors own in excess of 80 per cent of the tools and drill in excess of 80 per cent of all the wells. That is, oil well drilling contractors handle annually operations involving (U. S.) $800,000,000 in costs of which about (U. S.) $500,000,000 passes directly out of and into the hands of the contractors. This is a major industry the costs of which the people of the nation have to pay in the prices they pay for petroleum products. The contractor's responsibility is clear.

When oil reserves in the nation are calculated there are two figures that must be taken into consideration; first, the price received for a barrel of oil in the lease tanks and, second, the cost of placing that barrel of oil in the tanks. The first, the price, is or should be controlled by supply and demand. The second, or cost per barrel, is made up of all the exploration and lease expenses, well costs, and producing costs. The final figure is controlled by the efficiency with which the entire program is carried out together with the natural conditions encountered in the region, field, and well.

Thus the contractor as the driller of the wells bears responsibilities equal to or greater than the geological and land departments and the producing department for the price of petroleum products to the consumers and the reserves to be used for the benefit of the nation. How well has he played his all important part?

Ready to Serve

At the present time the drilling contractors own and are prepared to operate rigs that are capable of drilling probably 25 per cent more wells than are being drilled today. It is believed that about one-third of the tools in the country are stacked and that most of them belong to the contractors. Company tools are the last to go on the

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rack. Thus the contractor is maintaining a readiness to serve that assures an adequate supply of oil for the nation so long as the geologists and geophysicists and the old-fashioned wildcatter can find new fields.

Only a few years ago when oil was easier to find and the demand much less than at present, the contractor generally operated by rule of thumb methods and from the experiences of years gone by. Then, too, the oil companies operated in a quite similar manner. As the demand increased and wells of necessity were being drilled to greater depths, and as costs had to be maintained at the lowest possible level, the drilling organizations trained themselves to operate on sound principles of engineering. Engineers were brought into the organizations as drilling engineers, mud engineers, mechanical engineers, and just engineers. The companies led the field in adopting these principles, but there were also contractors who went along with them and sometimes led in practical results. Drilling crews became more capable and efficient through study and selection.

Back in those years probably as many as 40 per cent of the wells were drilled by company tools and in some areas even a higher percentage than this. As drilling practices were improved and equipment too, the contractors adopted them and gradually increased their percentage of wells drilled until the present 80 per cent was reached. In time this percentage will doubtless increase further.

More Wells Drilled by Contractors

In earlier years it was the accepted principle with many producing companies that they would own any number of strings of tools that they could operate continuously. During peaks of drilling requirements they would give the extra locations to contractors to drill. Now that is changing and the contractor is given the responsibility of a greater percentage of the wells because he has become a more efficient workman.

Statistical information is not available at the moment for this article is being written in a foreign land so it will be impossible to go back more than twenty years in considerations of well costs.

Increased Efficiency Reduces Cost

There are fields in California that have been under development for twenty years or a little less. The cost per foot of hole drilled today is as much as 20 per cent less than in the earlier years in several of these fields! And this in the face of rising payroll and all other operating costs—increases as much as 50 per cent or more! And the benefit of this reduction in drilling costs is passed on to the operating company and thence on to the public! The well digger retains none of it.

What is true of California is equally true of the remainder of the country.

This greater efficiency resulting in lower well costs and cheaper oil insofar as its part is concerned, is the primary objective of the oil well drilling industry or the oil well drilling contractor. His efforts to improve his operations and reduce drilling costs are being amplified as knowledge is disseminated and as practices are improved. Thus the part of the drilling contractor in the oil industry is to reduce the cost of drilling oil wells and thereby reduce the cost of petroleum products to the consumer and to add to the nation's stores by making otherwise marginal fields operable reserves.

☆ ☆ ☆ ★★★

The American Association of Oilwell Drilling Contractors will begin its ninth annual meeting September 19, at the Baker Hotel, Dallas, Texas. Governor Allan Shivers of Texas will speak September 21.

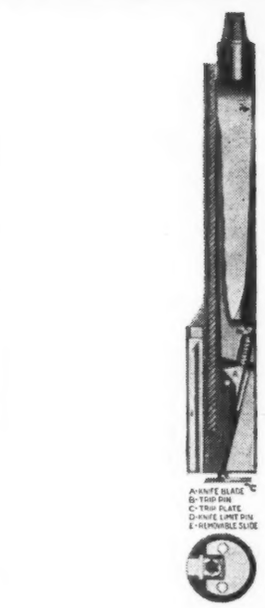

Fig. F450

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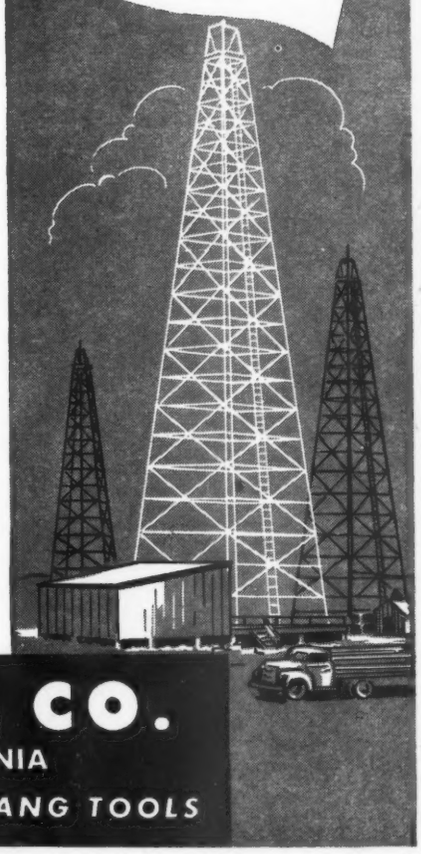

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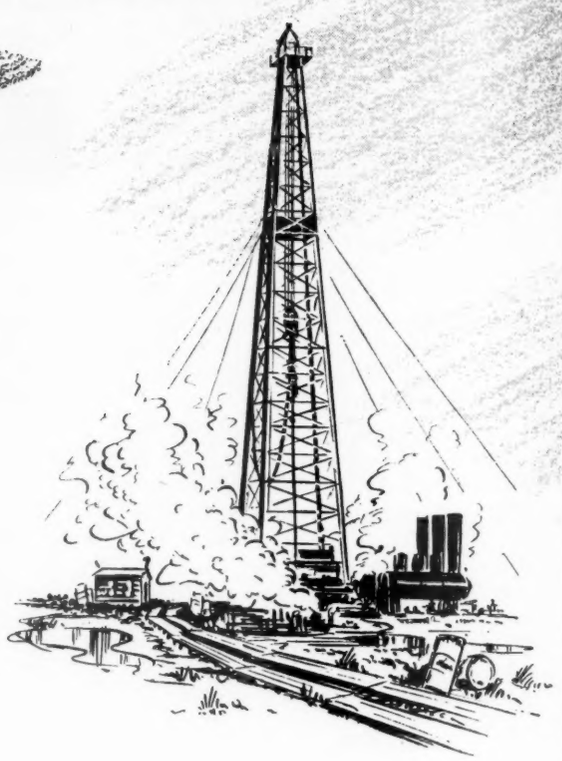

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The 22-billion-dollar Petroleum Industry is the world's fastest growing business. In its 90-year history it has never slowed its pace. Today it furnishes 48% of the world's total energy.

Such accomplishment was not accidental. The road was not smooth. This industry gained its place by vision, study, planning, hard work.

Giving credit where credit is due puts a high percentage of Petroleum Industry success on the head and shoulders of the Drilling Contractor. Most of the Industry's 2,000 contractors are men who "got their's the hard way." Few of them started with little more than a knowledge of hard work and the willingness to do it. They didn't look back at failure; nor were they spoiled by success. Much of America's production is owned by Drilling Contractors . . . results of their own findings. Today they drill 80% of the nation's wells. Many large oil companies were formed by Contractors who planted the seed, nurtured the operation, guided the destiny.

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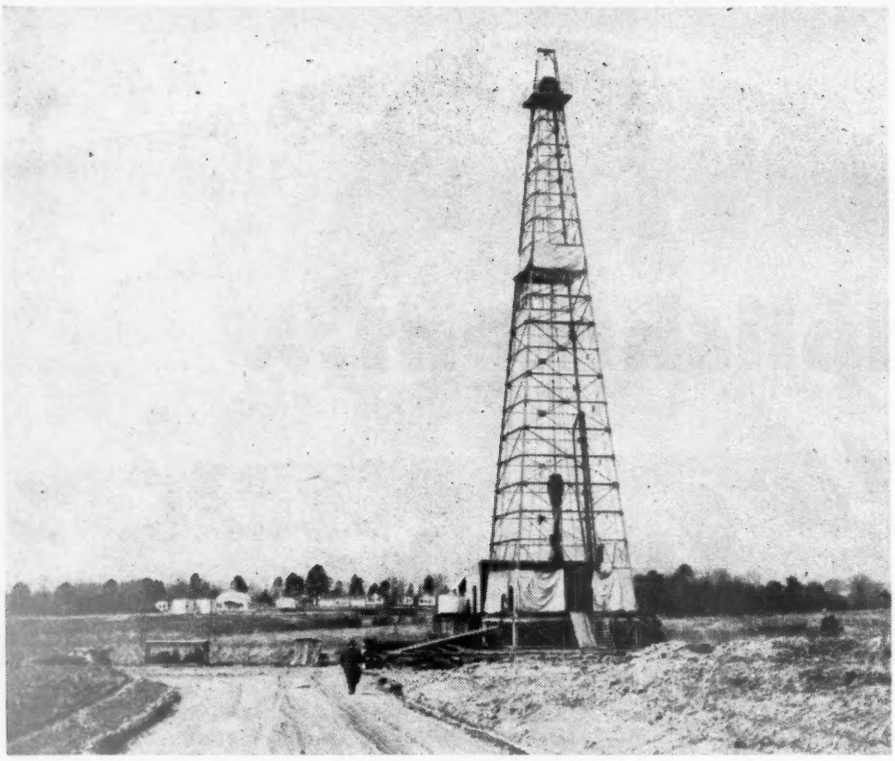

Drilling California Company well in Brookhaven field.

Mississippi

Late Drilling Operations

JACK HANCOCK*

MISSISSIPPI has chalked up six prospective oil fields so far in 1949, with both development and exploratory drilling continuing throughout the state at a rapid pace.

Of the six, three are listed as proven fields; one late discovery well is proving uncertain but operators are hoping an offset will be drilled; and the latest strike is not yet completed as this goes to press.

One interesting point so far is that five of the six prospective new fields are in the Southwest Mississippi area; the other is in the far Southeast.

According to State Oil and Gas Board records, 55 wildcats were completed during the first six months of 1949, of which three were discoveries; no figures are as yet available for the period since then, but three prospective fields have been discovered.

Bude field, in Franklin County, still an enigma to geologists and drillers, was brought in in February as the year's first field discovery; Sand Hill in Greene county in the far southeastern part of the state, was found in April; the Armstrong field in Adams county, which is heralded as one of the fine discoveries of the state, was brought in in May.

Of the most recent, the Russum prospect in Jefferson county, Stanolind Oil and Gas Company's Dockery No. 1, Sec. 17-10N-2E, is currently somewhat disappointing due to the fact that operators are experiencing difficulty in completing it as a flowing well.

A prospective well, which would be Lincoln County's third field, is the Big Chief-W. B. Osborne's George Ziegler No. 1, Sec. 2-6N-7E, which has shown disappointing completion results and current reports say the well may be plugged.

There is talk of an offset well, however, as the discovery came in making an estimated 200 bbl a day on first gauge, with considerable salt water during the 72-hr test. Original perforations were at 10-553-70 ft with the last tests at 10,553-57 ft. Operators have run several unsuccessful squeeze jobs.

The State Geologists Association, which works with the Oil and Gas Board in naming new discoveries, has taken no official notice of the Hartman prospect, as some feel that it may be a part of the Mallalieu field, which is three miles east.

Currently, interest is high in another Jefferson county prospect. Danciger Oil and Refining Company's No. 1 Mrs. Kate S. Logan. Although this test is being drilled "tight," drillers are reported to have struck a 9-ft gas condensate sand at 9401-10 ft.

The Logan well is about 12 miles west of the Russum prospect, in the northwest part of Jefferson county, only about three miles from the Claiborne county border.

Bude Interesting Discovery

Of the discoveries and prospects so far this year, probably the Bude strike has created most interest. Discovery well was the Barnsdall Oil Company's No. 1 J. Pittman, Sec. 29-5N-4E, which proved out for a fine well of 43 gravity oil — but other tests have largely proved disappointing. So far there have been 9 dry holes abandoned in the Bude field, and only two producers, with one well drilling at present. The discovery well is making 12,000 bbl of oil monthly. It was spudded 11-30-48 and completed 1-31-49. The well was drilled to total depth of 11,300 ft and perforated 11,120-135 ft. On initial test, it flowed at rate of 356 bbl per day of 43.8 deg. oil on 11/64-in. choke with no water. Tubing flowing pressure was 2150 psi. Shut-in pressure was 2270 psi. GOR was 1580 cu ft per barrel of oil. Accummulated production from completion to June 30, 1949, is 61,112 bbl.

Next in interest of the year's discoveries is probably the Armstrong* field of Adams county, which now has two producers with locations set for two more. Much of the area in the prospective field limit is in the George

*Oil Editor, *Jackson Daily News*.

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*The State Geological Society refers to this as the Ellislie field.

Armstrong estate, which Armstrong recently deeded to the Jefferson Military Academy, a Presbyterian school for boys at Washington, near Natchez. The discovery well is making 3500 bbl monthly and is interesting because of shallow production in an area where most other production is very deep. The discovery well, the Sohio-Jones-Kemp No. 1 George Armstrong, Sec. 36-5N-3W, was drilled to 6520 ft and produces from the Wilcox at 6467-71, making crude of 38 deg gravity. At present, the field has one other producer with another test drilling.

In April, Humble Oil and Refining Company completed No. 1 F. J. Hubbard, Sec. 3-4N-8W, for the discovery well of the Sand Hill field in Greene county.

On initial production the well pumped 46 bbls of 25-gravity oil from perforations at 7804-12 ft in the Upper Tuscaloosa horizon. Further development of this pool is expected with the structure appearing to be a faulted area. Humble at present has location staked for a wildcat test approximately 3 miles west of the discovery. The total accumulated production from the one well in the Sand Hill pool to July 1 is 1008 bbl.

Find 44th Salt Dome

Wildcat drilling during the year has established the existence of three more piercement type salt domes, bringing the total known salt domes in Mississippi to 44.

The Carmichel dome located in southwestern Hinds County was discovered by Southeastern Drilling Company at its No. 1 Lewis-Erwin, Sec. 27-3N-3W, with total depth of 325 ft and bottomed in salt.

The second salt dome discovery for the year was also in Hinds County and is known as the Oakley dome and was discovered by Sun Oil Company at No. 1 H. T. Shuff, Sec. 27-5N-3W. This well encountered some oil shows at approximately 2500 ft, which proved uncommercial upon testing and the well was abandoned at 2634 ft in salt.

The third salt dome discovery of the year was in Jones County at Walter Sistrunk's No. 1 H. C. Powell, Sec. 18-8N-13W. Total depth of this well was 2068 ft with bottom hole formation being salt and the dome designated as Centerville.

Numerous sulphur tests have been drilled on several of the known shallow salt domes in Mississippi during the past five years; however, to date no commercial sulphur deposits have yet been found but further sulphur explorations in these areas is to be expected.

Firm Awarded Oil Lease on Adams Lands

Vaughey and Vaughey, independent operators of Jackson, Mississippi, made a successful bid on 503 acres of school lands in Section 3-6N-4W, in Adams County, Mississippi.

Under the one-year lease agreement was the stipulation that a test well would begin within 90 days after August 1, the date the lease became effective.

The Adams County Board of Supervisors accepted the second bid of Vaughey and Vaughey under which the operators would pay the county $101,000 in cash and one-quarter royalty until all costs were recovered. After that time, the county would receive one-half royalty. Two other bids which were submitted by the same operator included one with a cash bonus of $1,000 and one-half royalty and another with $151,000 cash and five-sixteenths royalty.

Closest bid to that of Vaughey and Vaughey was that of Humble Oil and Refining Company, which called for a cash payment of $215,179 and one-quarter royalty.

Tinsley Revival

A development in the Tinsley field, Yazoo county, which has revived drilling interest to some extent, was the completion by Hassie Hunt Trust's No. 5 J. C. Johnson NW SE, Sec. 11-10N-3W, which was completed as a flowing well in the Lammons sand of the Eutaw series at 5090-5100 ft. This sand is productive in the northeast part of the field but is the first production obtained in the Lammons sand south of the major fault line in the field. Tinsley was the first oil field in Mississippi and since its discovery in September of 1939 has produced a total of 109,825,940 bbl of oil to July with the majority of production being obtained in sands at the base of the Selma chalk. The current monthly production at Tinsley is approximately 475,000 bbl of oil from 283 wells.

Deep Pickens Test

The Carter Oil Company has staked a location for a proposed 11,000-ft venture in the Pickens field of Yazoo and Madison counties to test the possibility of production in the smackover lime. This could be a significant development in the state's oil industry. Pickens, approximately 25 miles northeast of the Tinsley field, was discovered in the spring of 1940 for the state's second commercial oil field strike with all production found in the Eutaw sand series at approximately 5000 ft, and the possibility of deep production has long been discussed in this area.

During June of this year, Wilcox production was established in the Oldenburg field of Franklin county, by Hodge-Gilster-Kemp at their No. 1 Lehman Brothers, SE NW Sec. 28-7N-2E. Total depth is 6055 ft with initial production test from perforations at 5984-5987 ft making 246 bbls for 24 hrs through 11/64-in. tubing choke. Tubing pressure was 420 psi and casing pressure 380 psi with the gravity of the oil set at 35.5 API. Since the discovery of the Wilcox horizon at Oldenburg, one other well has been completed in this sand and one dry hole recorded with two other tests currently drilling in the field. Oldenburg was discovered in the fall of 1947 with the discovery well being completed as a small pumper in the Massive sand of the Lower Tuscaloosa series below 10,500 ft. Development of the field to date has been slow due to the fact that two offsets to the discovery well failed to establish production in the Massive sand. Relatively shallow production in the Wilcox may increase drilling activity in the field in the latter part of this year.

Coring is continuing below 9456 ft at the Danciger Oil and Refining Company No. 1 Kate S. Logan, Sec. 18-T10N-R1W, Jefferson county, with no detailed information being released by operators, but from results of 15-minute drillstem test, which was run recently, a gas-condensate discovery of perhaps major importance appears imminent. Interval tested 9395-9413 ft, ¼-in. top and bottom choke and 1500-ft water cushion. Good blow recorded and flowed water cushion, gas and condensate into pits with surface working pressure 1150 psi. Recovered 271 ft of condensate, 400 ft water cushion, mud, no formation water. Bottom hole flowing pressure 4000 psi, shut-in bottom hole pressure 4200 psi.

Wildcat drilling activity throughout the state is expected to remain steady during the last quarter of this year with several excellent geophysical prospects to be explored. * * *

Derrick substructure and engine room sound-proofed. Note covered doors and crownblock opening; also blanket tucked up on crown block for emission of air for ventilating purposes. This derrick in La Habra Heights.

Sound-Proof Derricks

J. C. ALBRIGHT

DERRICKS with specialized sound-proofing are being used in greater numbers, as time goes on, to reduce the noise of drilling operations in residential areas in which the people object to extraneous sounds. In localities and subdivisions where the surface rights and title to lots do not include royalties or any sort of participation in the income from produced oil or gas, the drilling contractors and producing companies are particularly careful not to antagonize surrounding home owners by the noise of drilling engines and sounds somewhat foreign to people not interested in well drilling. In certain parts of Southern California sound-proofed derricks are employed freely such as the current campaign in the Howard Community area of Athens-Rosecrans and in La Habra Heights, east of Los Angeles, where a number of directional wells are being drilled from an inconspicuous central location.

The predecessor of sound-proofed derricks was the structure sheathed with corrugated sheet metal from substructure to crown block. This type of sheathing served to prevent oil and mud spray from disfiguring the immediate neighborhood, but was a poor screen for sounds originating on the derick floor or in the engine room. Among the first derricks to be completely sound-proofed from an angle that was intended to screen completely the sounds of drilling was one erected near Gilmore Stadium by Shell on a deep exploratory test. This derrick, and others that followed immediately were sheathed with material not easily salvaged.

Experimentations with soundproofing led to the use of blankets that reduce the sounds of drilling. These blankets are tailored for certain types of derricks and can be used interchangeably on several rigs of the same style or size.

Blanket Sections Numbered

Some of the blankets for soundproofing are made of two sheets of heavy tarpaulin or ducking with a thick layer of rock wool quilted and stitched like a heavy bed comforter. When these blankets are fabricated, each section is numbered so as to aid the derrick builders when applying the soundproofing. Both sides and each end are equipped with metal eylets, or grommets, so the blanket unit can be hung on the derrick by lacing with cordage at the legs of the derrick where the ends meet, and with heavy wire hooks at the sides where the edges meet the girts and sway-braces.

A complete set of blankets,* sufficient to cover the derrick, the engine room, and the pumps may be purchased outright, or leased by an operator or drilling contractor for a

*Manufactured by Macco Corporation, 14409 Paramount Boulevard, Paramount, California.

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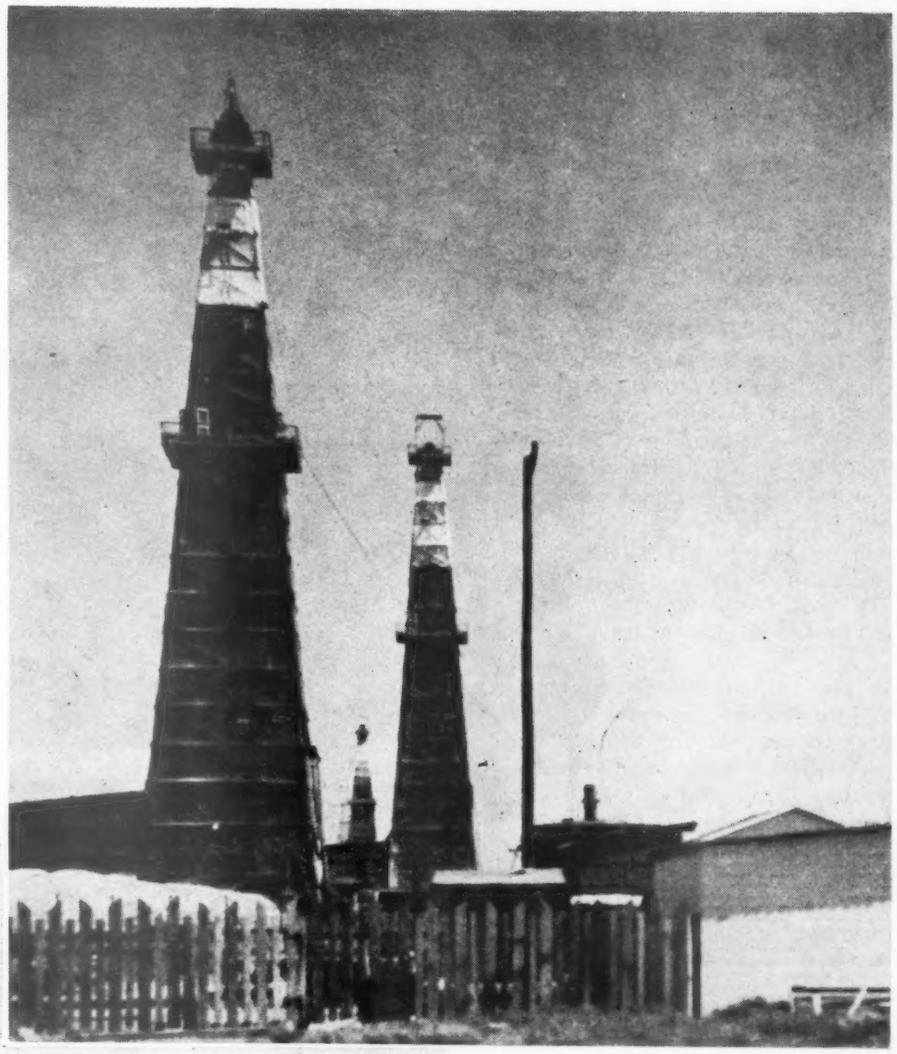
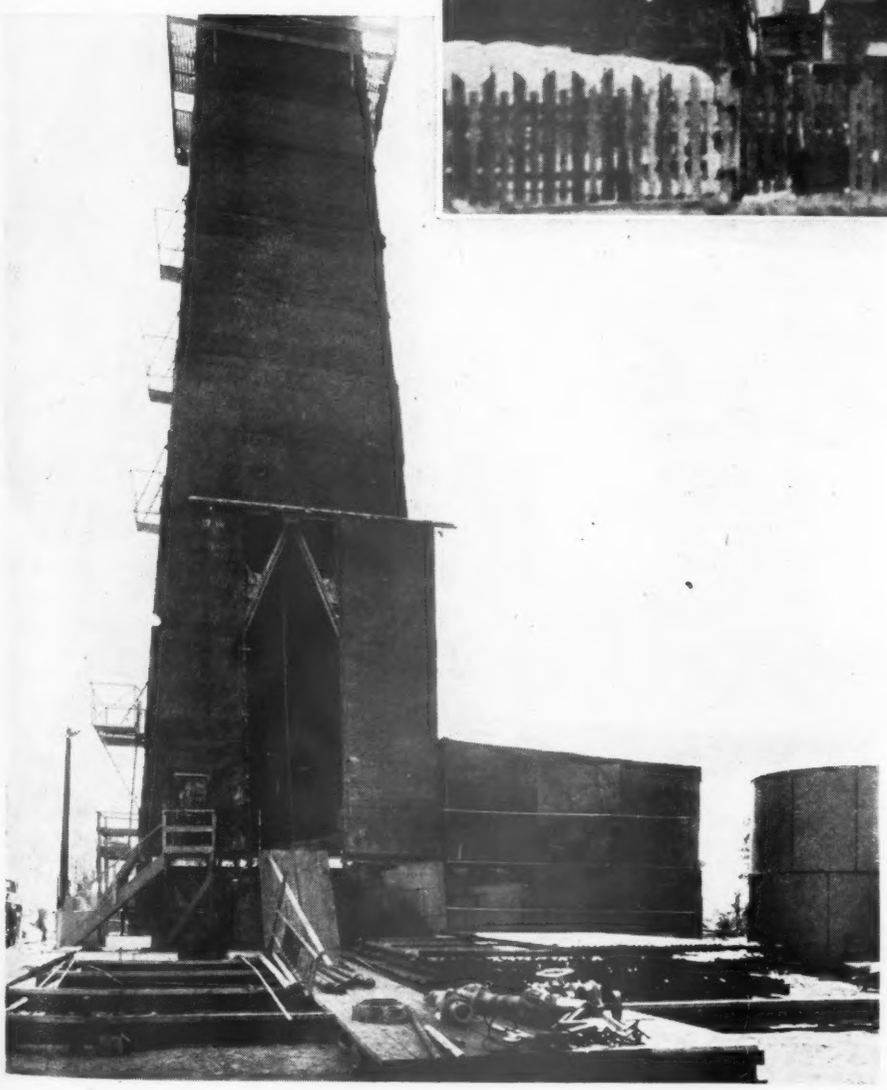
specified amount of money based on the length of time the set of blankets is employed on the derrick. The service includes application, servicing, and removing the sound-proofing after the well has been completed.

A set of blankets for a complete sound-proofed job, including the derrick structure covering, housing of the engines and pumps, and closing in the substructure, weighs about 5 tons, depending upon the type of derrick used, the height of the substructure, and other variables. The material is flame resistant and may not be damaged much by a flash fire, but it is not completely fire-proof. The fabric or the rock-wool filling is not harmed by mud or oil, except as the surface becomes contaminated, depending upon the amount of splash and spray from the well or the wire lines.



Group of three sound-proofed derricks in Athens-Rosecrans Howard Community area. They are painted regulation colors at the top as plane warnings.

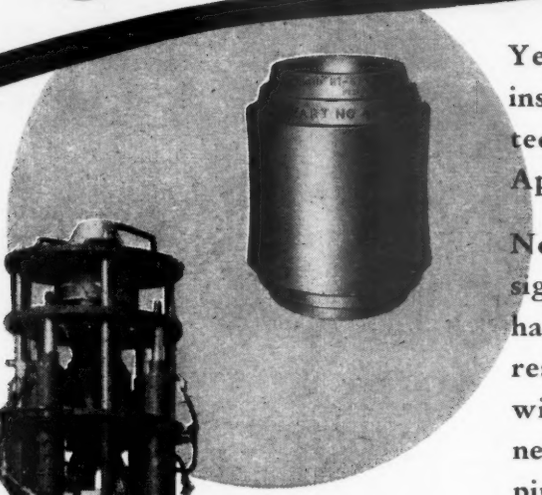
Piperack side of sound-proofed derrick, showing large door on rollers. The door is opened sidewise.



More Lights Required

It is necessary to increase the amount of interior lighting about 100 per cent as the olive drab shade of the covers absorbs much of the light from the electric bulbs. Ventilation is not much of a problem as the derrick acts somewhat like a tall chimney. The air ascends readily when the blankets are parted at the crown structure to provide an outlet for the heated air from the derrick floor. It is obvious that the wind load is increased, and it is usually desirable to attach guy lines as braces, which is common practice in many parts of the country with uncovered derricks. Communication between the driller and the derrick man is not particularly complicated, as many rigs are equipped with an intercommunication system to obtain clarity of instructions from the floor to the fourble board and vice versa. * * *

in just *One Minute!*



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Pumping Equipment for Water Flooding Projects

ED CARAWAY*

PUMPING equipment for a water flooding program would be selected from a consideration of relatively the same factors as for any other pumping application. The calculations for an application on a water flooding project might be more nearly correct than for many other applications where fewer facts about the production are known. This statement is based on the thought that it may be possible in many instances to arrive at the maximum amount of fluid to be raised, the approximate pumping fluid level, the percentage of water at which wells will be abandoned, and possibly a close approximation of the pumping life of the wells. It is agreed that each project would present a different problem with varied loads and operating conditions, but it should be easier to select or calculate the maximum to be expected on these older wells than it would on new wells in a new field. A discovery well, for example, would present several unknown factors, if it required pumping. The volume of oil or fluid would be unknown. The percentage of water to be expected, and the pumping fluid level would be a rank guess in most cases. Experience and observation should offer some basis from which to work on older production.

For the selection of pumping equipment for a water flooding program, we should take whatever facts are available and assume the remainder based on what the program planned to accomplish. Two methods are used as an illustration. The first method is usually referred to as a "five spot" program, and the second method as a "line drive" program. Figs. 1 and 2 show small diagrams to indicate the spacing of each and the direction of water drive.

*Division Manager, Lufkin Foundry & Machine Company, 1317 Magnolia Building, Dallas 1, Texas.

EXCLUSIVE

Five Spot Method

As an illustration of the five spot plan, we will assume the field is 2000 ft deep and drilled on a program of one well to each 10 acres. Water is to be injected into each water input well at the rate of 5 bbl of water per day per ft of pay. Assuming a 35 ft pay section, this would indicate an injection rate of 175 bbl per day per well, which rate is assumed to be the maximum necessary to pump from each oil well. Each oil well is surrounded by four equally spaced water injection wells, and it is assumed in our planning that the injected water will spread in a circular zone from each injection well forcing oil before it as it spreads.

This water drive from the four corners will force oil toward the well from which it will be pumped to the surface. It follows that the initial production after the program is instituted will be almost 100 per cent oil and at the optimum stage of this program the well might produce as much as 175 bbl of oil per day compared with a very few bbl per day when the program is begun. As the spread of water increases and as the water drive channels through to reach the oil well, the percentage of water will increase until the oil well is producing almost 100 per cent water. Each oil well will be affected in a similar manner, as each is surrounded by the equally spaced water injection wells.

Line Drive Method

The line drive injection method is based on injection of water along one particular edge of the field, and, as the water line moves over into the field the 100 per cent water wells are abandoned as oil wells and may be converted into injection wells. It is usually true in such a program that some areas along this "drive line" will be more permeable or will channel to a greater extent than others and the "flood front" will not be straight or uniform, but this method has been highly satisfactory in some fields. The Haynesville Operators Committee, operating in the Haynesville, Louisiana field with a line drive plan, is one of several that have shown good results. Several programs in Arkansas and North Louisiana have been in operation for a sufficient period to indicate a very profitable return from the programs with a high ultimate recovery. It is generally assumed that 75 per cent of the water injected in a line

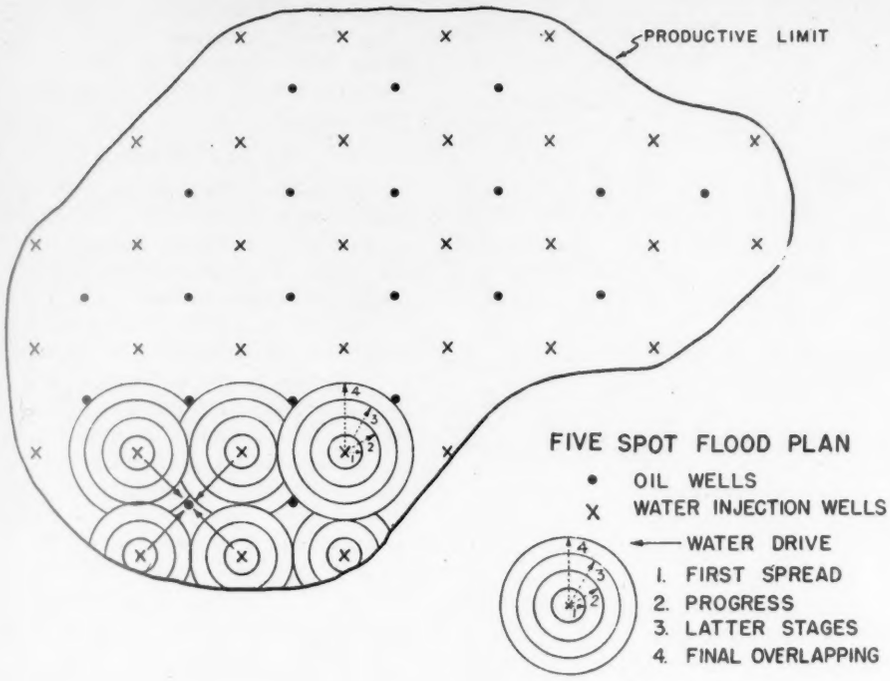


FIG. 1

drive plan will be produced eventually from offset oil wells, so, if it were assumed that 400 bbl would be injected, then the offset oil wells should return about 75 per cent or should pump 300 bbl per day.

It is true that not all programs will be pursued according to the plans indicated. The nature of the field, the spacing of wells and other factors will alter in many respects the planning for each individual field and each program. It is possible that a combination of the five spot and the line drive method might work most successfully, and it might be possible to spot injection wells at various points to more economically carry out the purpose of the program. A close study of field and well characteristics is necessary before a plan is adopted, and each plan would vary to some extent from others. It may be possible in many instances to gather information on some operation whose conditions are similar to those you anticipate. This should give a firmer basis on which to plan and pursue your program.

Pumping Equipment

Selection of size and capacity of pumping equipment for such a program should be based on well load and fluid volume. In order to calculate well load and select equipment of proper capacity, it is necessary to know (1) the maximum amount of fluid to be produced per 24 hr or the volume to be produced per hr and (2) the depth to the pump. On a water flooding program, fluid level might be assumed at bottom, as water and oil might be produced about as fast as it comes into the hole.

If information is available on the pumping fluid level, it may be possible to place the working bbl at some point above the bottom of the hole that will give submergence at all times. If this pumping fluid level is not available, or if it is felt that it may later pump down, it is assumed that a full string of rods will be run and pump set near bottom of hole.

Size or capacity required is based on peak polished rod load (PRL) and peak torque (T) which may be calculated from the amount of fluid to be produced daily from a given depth.

Peak polished rod load (PRL) =

$$WO + WR\ (A)$$

Where WO = Wt of fluid, lb

WR = Wt of rods, lb

A = acceleration factor

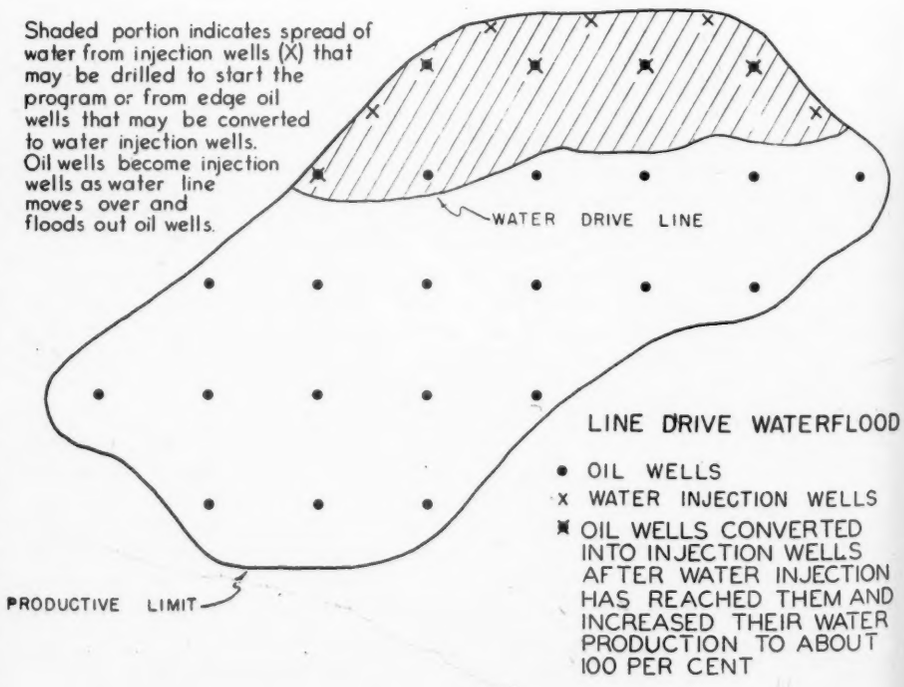
The result of these calculations is the indicated load (in lb) suspended by the polished rod from the horsehead of a pumping unit beam.

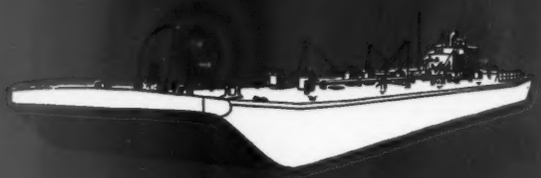
Peak torque (T) is the result of net polished rod load multiplied by crank arm length (½ the stroke length).

Net polished rod load is equal to peak polished rod load (PRL) minus counterbalance. If actual required counterbalance effect is known, it is suggested that it be deducted from PRL, otherwise general practice is to assume that 60 per cent of PRL will be counterbalanced, leaving a net polished rod load of 40 per cent PRL.

Some use a theoretical maximum counterbalance effect as the sum of all rod weight plus half the weight of the column of fluid. We believe it will give an inaccurate figure if used as the actual counterbalance effect in figuring peak torque, especially on shallow wells. Experience accumulated from years of checking actual requirements led API to accept the figure of 60 per cent of peak polished rod load as the

FIG. 2


Shaded portion indicates spread of water from injection wells (X) that may be drilled to start the program or from edge oil wells that may be converted to water injection wells. Oil wells become injection wells as water line moves over and floods out oil wells.
WATER DRIVE LINE
LINE DRIVE WATERFLOOD
OIL WELLS
WATER INJECTION WELLS
OIL WELLS CONVERTED INTO INJECTION WELLS AFTER WATER INJECTION HAS REACHED THEM AND INCREASED THEIR WATER PRODUCTION TO ABOUT 100 PER CENT
PRODUCTIVE LIMIT



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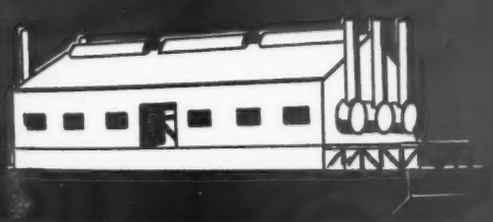

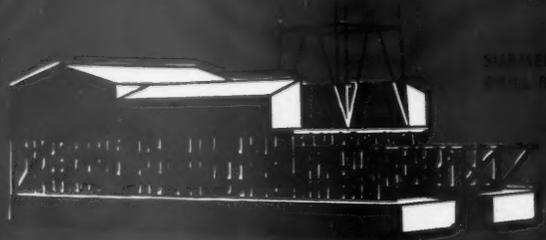

expected counterbalance requirement. In some instances this will indicate more counterbalance effect than is actually required. On extremely deep wells, however, the percentage of total load that might be counterbalanced will be proportionately greater as rod weight will be comparatively much greater than fluid weight. We believe that 60 per cent of peak polished rod load should be used as counterbalance in all calculations for peak torque requirement where the actual counterbalance requirement is not known. On wells of average depth this amount of counterbalance (60 per cent of PRL) should fill all requirements. If a theoretical maximum amount of counterbalance is deducted from the peak polished rod load and a very small net load is indicated, the equipment selected from those calculations would be overloaded seriously should it be found that not as much load could be counterbalanced as was calculated. Peak torque is derived from net load times one-half stroke length and net load is equal to peak polished rod load less actual counterbalance effect.

This thought should support my method of using actual counterbalance effect or 60 per cent of PRL rather than the calculated counterbalance effect, which assumes that all load can be counterbalanced except one-half of the fluid weight.

Peak torque derived by multiplying net load by one-half stroke length is the torque loading that will be imposed on the speed reducer of the pumping unit. In the absence of tables, the following calculations should supply about the same results.

Peak polished rod load (PRL) = WO + WR (A)

WO = Wt of column of oil or fluid, lb
= (pump diam squared) (0.34) (depth in feet)

WR = Weight of rod string
= (Length of rod string in ft) (Wt per ft)

$\frac{5}{8}$-in. rods weigh 1.18 lb per ft
$\frac{3}{4}$-in. rods weigh 1.64 lb per ft
$\frac{7}{8}$-in. rods weigh 2.20 lb per ft
1-in. rods weigh 2.88 lb per ft
(Rods by different manufacturers may vary slightly in wt)

A = Acceleration factor

$$= 1 + \frac{\text{SPM}^2 \times \text{Stroke,in.}}{70{,}500}$$

To illustrate how this information may be applied to equipping and operating a pumping well, let us assume a theoretical set of conditions and determine suitable equipment and operating speed for obtaining the desired production. Well conditions will be assumed as follows:

Pumping depth = 2000 ft
Fluid level = near bottom
Production = 175 bbl of oil and water

In arriving at operating conditions, one of the important factors is speed of operation. This may be determined theoretically by use of Slonneger's formula as follows:

$$\frac{237{,}000}{\text{Depth in ft}} = \text{Frequency}$$

For our assumed depth, the frequency would be

$$\frac{237{,}000}{2000} = 118.5$$

Experience has shown that pumping speeds of an uneven or half order such as:

$$\left(\frac{118.5}{4.5} = 27 \text{ SPM}\right)$$
$$\left(\frac{118.5}{5.5} = 22 \text{ SPM}\right)$$
$$\left(\frac{118.5}{6.5} = 18.5 \text{ SPM}\right)$$
$$\left(\frac{118.5}{7.5} = 16 \text{ SPM}\right)$$

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produce the most harmonious motion in a rod string. From the above favorably indicated speeds, 18.5 SPM is the "logical" speed as a relatively large volume of fluid must be produced and as speeds in that range are satisfactory at this medium depth. Speed of operation is not as important, however, on shallow wells as it is in deep wells.

From a calculation of displacement, we find that a 1¾-in. working barrel and a 34-in. stroke should produce about 175 bbl of fluid working at 80 per cent efficiency and 18.5 SPM. As ¾-in. rods should do a better job with less stretch and with more surplus capacity than ⅝-in. rods, my thought would be to use ¾-in. rods instead of ⅝-in. rods. This selection is based on the expectation of fewer rod breaks, less down time, less pulling cost, and fewer lost producing hours or days. Company policy may dictate occasionally what should be done and the amount of freedom that is allowed in the selection and application of equipment. Almost without exception, however, it will be found that a few dollars saved by cutting corners on the application of equipment will be spent later by the production department on repairs and maintenance. Your sucker rod supplier should be pleased to engineer your rod string and suggest the best application.

Applying these assumed conditions we have the following calculations:

$$PRL = WO + WR\,(A)$$

$$WO = (1\tfrac{3}{4}\text{-in.})^2 \quad (0.34)\ (2000) = 2080 \text{ lb}$$

$$WR = (1.64)\ (2000) = 3280 \text{ lb}$$

$$A = 1 + \frac{(18.5)^2 \times 34\text{-in.}}{70{,}500}$$

$$= 1.165$$

$$PRL = 2080 \text{ lb} + 3280 \text{ lb}\ (1.165) = 5{,}900 \text{ lb}$$

Net load = PRL less counterbalance or = (0.4) (PRL)
= (0.4) (5900)
= 2,360 lb

Peak torque = (net load) (½ of 34-in. stroke)
= (2360) (17)
= 40,000 in.-lb

From this illustration it appears that a 34-in. stroke unit in the range of 40,000 in.-lb peak torque rating should be selected. Standard design practice is such that most units with a gear rating in this range will also have beam capacity and maximum stroke lengths in about the same range as indicated. I believe gears are rated by API formulas to the greatest allowable loads, and I would seriously discourage the gamble of placing a unit on a well load calculated to be greater than the rating of the unit. Volumetric efficiency is often assumed as 80 per cent. On wells of medium depths between 2000 ft and 4000 ft, however, where it is assumed that rod stretch would not be appreciable and no allowance is made for rod stretch, I think it might be safer to figure approximately 70 per cent overall efficiency. This allows for sub-surface irregularities that are not taken into the calculations and also allows the pump to operate for a longer period with greater wear and still give the required production.

Seventy per cent volumetric efficiency with a 34-in. stroke, 18.5 SPM, and a 1¾-in. barrel indicates production of approximately 160 bbl of fluid. Maximum requirement was assumed as 175 bbl per day. The safety factor would be the ability to pump faster than 18.5 SPM, if required, although this was indicated as one of the optimum pumping speeds. (Well conditions could change these frequencies and rod harmonics, and, while the foregoing method of calculating SPM

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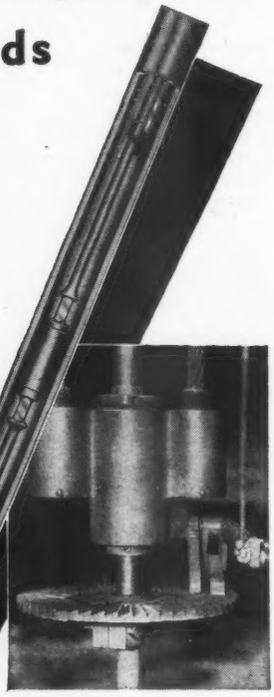

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This rod hanger rotates the rod string a fraction of a turn on each reciprocation. The horizontal teeth on the turn table are engaged by two ratchet levers which are actuated by a flexible steel cable attached to the walking beam. On each reciprocation the levers move the rod string a fraction of a turn.

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might be correct for 70 per cent to 80 per cent of applications, it is desirable to check rod and pump action by dynograph, which may indicate a pumping speed more favorable than the calculated speed). Also, as mentioned above, harmonics are not as important to the operation of shorter rod strings that have short travel.

The discussion to this point has been limited to wells less than 5000 ft deep. In equipping wells from 5000 to 10,000 ft deep, it will generally be necessary to use combination rod strings and check rod stresses more closely. We suggest that you use charts and percentages supplied by the rod manufacturers. Pumping speeds are important on the longer rod strings. Slower, longer strokes are desirable, and it is more vital to consider rod string harmonics, rod and tubing stretch, pump over-travel and rod materials.

One company* has a very satisfactory data sheet, which is available to the oil profession, giving figures on fluid loads, rods, and well loads. Another company† has made and distributed a slide rule that gives assistance on deep wells with problems of rod stretch, tubing stretch, over-travel, combination rod strings, etc.

As mentioned, some accept 80 per cent pumping efficiency for average wells, although we believe safe practice will indicate an overall 70 per cent as a good figure when rod stretch and other factors are considered. When wells 7000 to 10,000 ft deep are pumped the overall efficiency of pump and machinery may be found much lower. It will, of course, be necessary to calculate the net travel of the pump plunger after allowance for rod and tubing stretch, etc., and on this net travel, experience indicates that you will get volumetric efficiency in the range of 70 per cent and 80 per cent and an overall efficiency of 50 per cent to 60 per cent. This may be explained partially by greater pressures and higher temperatures at those depths.

A study has been made on the pumping of wells from 8000 to 10,000 ft which was published recently.‡

Selection of units in the required capacity range should be made after a close study and comparison of design, materials, construction, performance, reputation, and price. Each of these factors is important in the comparison. Price, perhaps, should have the least consideration as your basic thought is to purchase the units that will most satisfactorily and economically perform the job to which it is applied.

Assuming the equipment is adequate for the loading, counterbalance is one of the most important factors in the operation. The addition or removal of a few hundred pounds of counterbalance will change the peak torque loading several thousand pound inches.

As an example of the loading imposed by an out of balance condition, let us assume that our previous example was 1000 lb underbalanced. Pumping from 2000 ft with a 1¾-in. bbl, ¾-in. rods, 18.5 SPM, fluid volume 175 bbl per day, we had a net load of 2360 lb times ½ stroke length (17) for a peak torque loading of 40,000 in.-lb. If the load was 1000 lb underbalanced, which would not be unusual, we would have a net load of 3360 lb times 17 for a peak torque loading of 57,000 in.-lb. If a unit with capacity of 40,000 in.-lb had been installed, it would be 42.5 per cent overloaded by this unbalanced condition. If an electric motor is used as prime mover, it is readily apparent from "whine" of motor whether the peaks on up and down strokes are about the

*The S. M. Jones Company, Tulsa, Okla.
†Axelson Manufacturing Company, New York City 7, N. Y.
‡The Lufkin Line, a publication of the Lufkin Foundry & Machine Company. Copies will be sent on request.

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Fig. 247
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same. A check of peaks and input power by instruments will show the necessity of accurate counterbalance. It may save many dollars in power costs and should add materially to the life of equipment by lowering peak loads.

In selecting pumping equipment for a water flooding project, we suggest the study of portable base units and flush type installations. Many wells may have a short anticipated life and the use of the portable base unit could save the expense of a concrete foundation. (See photo).

The flush type unit and the portable base unit use a cast iron or fabricated sub base between the gear case and the base rails to provide crank sweep above ground level. This sub base raises the gear box sufficiently to clear the crank sweep without sumps or high block. A higher samson post is also used with the sub base in order to maintain relatively the same pitman lengths and keep good pitman angularity. The saving of concrete block above ground level will usually more than pay the additional cost of the cast iron sub base.

Probably the greatest advantage other than elimination of above ground concrete block is in the low mounting of engine. The flush type mounting of unit places the engine only a few inches above ground level, which allows better access for starting. This low mounting is more convenient for service, repairs, and maintenance of engine.

The portable unit in addition to the sub base, is built with four full length beams for a base instead of the conventional 2 base beams. This gives a base arrangement approximately 7 to 8 ft wide and the full length of the unit, which would, depending on the size of the unit, be from about 15 ft to as much as 30 ft in length. These four full length rails are heavily cross braced together. Usually the volume tank and any other needed accessories are built into and as a part of this base arrangement. This portable base gives a rigid and sturdy base for setting unit directly on ground or on planks, which might be desirable to keep the metal above ground dampness. This arrangement eliminates need for any type of concrete base. This effects a saving in the initial installation and is desirable when it is known that the well will not last long or when a test is required before a permanent installation is made. ★★

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Nearly 225,000 men and women operate transportation and communications for their companies and more than 120,000 work in service and supply. The largest number of all, more than 1,150,000 provide consumers with oil products in the distribution and marketing phases of the business. This includes the 734,000 who work in service stations.

—B-A Newsvent T.P.L.

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PART 1

Hydraulic Torque Converters and Fluid Couplings for Oil Field Machinery*

H. A. DAVIS†

SECTION 1—Theoretical Discussion of Basic Hydro-Kinetic Units

DESIGNERS of modern oil field equipment have come to realize that the proper application of hydraulic drive units extends the capacity, improves the performance, and increases the wear life of the basic machine, and with this realization has come a tremendous increase in the number of installations.

In considering the wide variety of hydraulic unit applications which range from compressor to hoist drives, one can readily appreciate why a single make or type of hydraulic unit cannot possibly fill all performance requirements.

The main purpose of this discussion is to describe oil field applications of the various designs of hydraulic units, however, before this can be properly done it is necessary to define and explain the basic types of units and the simple theory upon which they operate.

Fundamentally, there are two distinct divisions of hydraulic drives; namely, the positive displacement or hydrostatic unit depending upon fluid pressure to transmit the power, and the turbo or hydro-kinetic unit depending upon fluid velocity to transmit the power. The positive displacement units, such as pumps and fluid motors, have not, as yet, made their appearance to any great extent in the oil fields, and therefore this discussion will be confined to the turbo type of unit in its various forms.

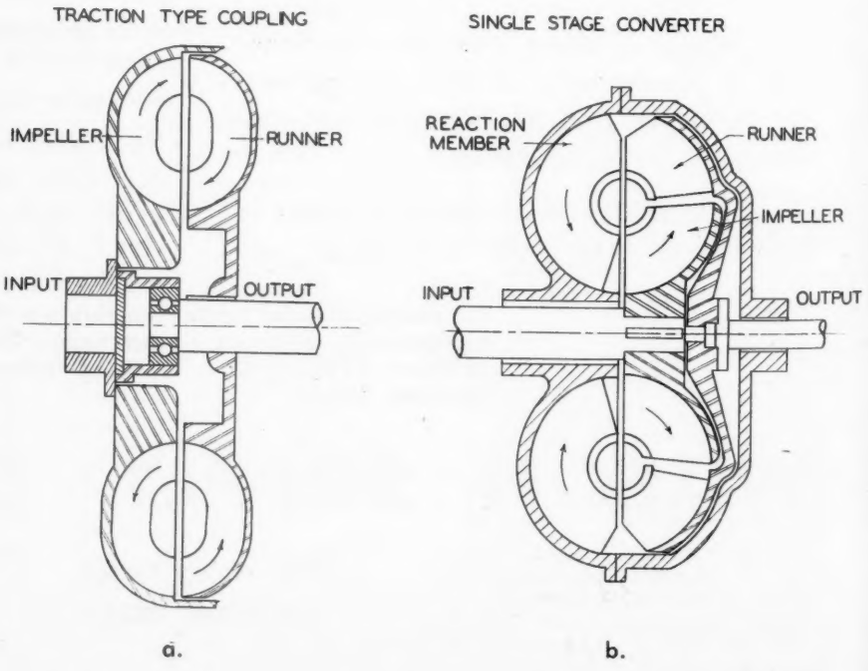
The hydraulic coupling and the torque converter are the two fundamental forms of the turbo or the hydro-kinetic drive units. Both depend upon the ability of fluid to absorb and then release kinetic energy in the form of increased and decreased velocity. The fluid circuits of both couplings and converters are annular or "do-nut" shaped chambers, because in such forms the circuits have greatest compactness and lowest fluid frictional losses.

The coupling has but two principal parts, the impeller and the runner, while the converter has three (3) principal parts, the centrifugal pump, the turbine, and the reaction member which is attached to the housing. These units are shown in Fig. 1 (a) and (b). In both units, the impeller, or pump, picks up the fluid at the center and imparts to it kinetic energy in the form of increased velocity as it travels outward radially. The fluid then passes through the runner or turbine, as the case may be, giving up its velocity or energy as it returns inward radially. In the case of the coupling, this kinetic energy is transmitted as unit torque with frictional losses becoming evident as slip, or lower output speed. The converter fluid circu. differs at this point from the coupling in that the fluid upon leaving the turbine blades, then passes through the reaction member blades which changes its direction of flow. Since the reaction blades are stationary and are attached to the housing, the resulting torque force due to redirection of the fluid is actually added to the input torque, resulting in an increased output torque; for as is well known, in a balanced system input and output torque forces must total zero. This statement can be expressed as the following formula:

$$\Sigma T = T_P + T_T + T_R = 0$$

The capacity for transmitting torque and horsepower for both hydraulic couplings and the converters is based upon well-known hydraulic laws and can be expressed, as follows: Torque capacity is proportional to the square of the speed. Horsepower capacity is proportional to the cube of

FIG. 1.



*Presented before Petroleum Mechanical Engineering Conference of American Society of Mechanical Engineers, Amarillo, Texas, October 3-6, 1948.

†Twin Disc Clutch Company, Dallas, Texas.

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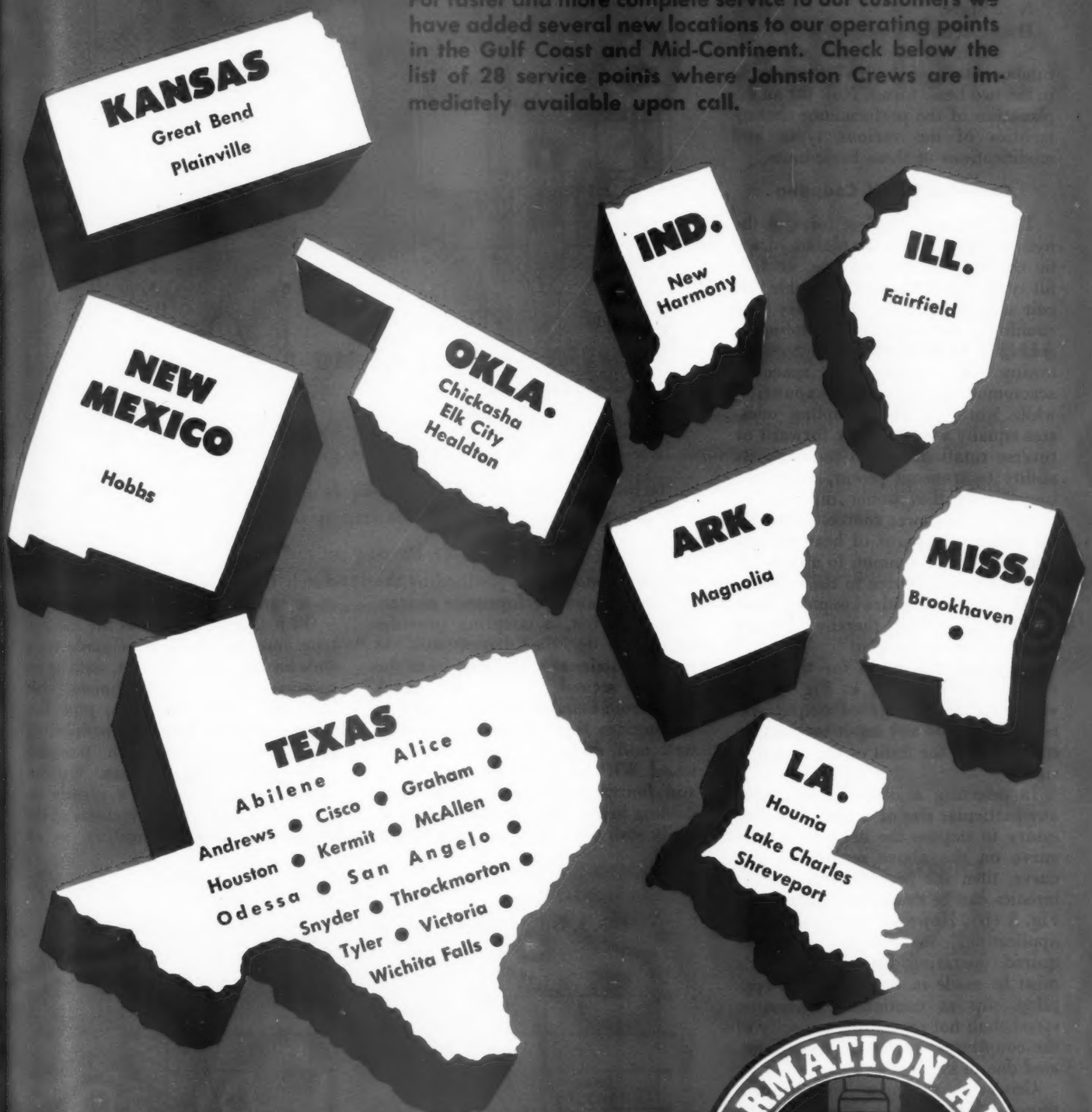

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the speed. Both the torque and horsepower are proportional to the fifth power of the circuit diameter. These facts can, therefore, be equated as follows:

$$T = C \times N^2 \times D^5$$
$$HP = C \times N^3 \times D^5$$

Where:

C = Circuit Constant
N = Speed
D = Circuit Diameter

So much for the discussion of the fundamentals of hydro-kinetic units in the two basic forms. Now for an explanation of the performance characteristics of the various types and modifications of these basic units.

Constant Speed Coupling

The first and simplest form of the hydro-kinetic unit is the plain hydraulic coupling of the traction, or full-fill type. Fig. 2 shows the double circuit coupling in the stationary and running condition. This coupling is generally filled to a definite level allowing only sufficient air space to accommodate the fluid expansion while working. This coupling operates equally well in either forward or reverse rotation, and in so far as its ability to transmit power, either the impeller or the runner may be attached to the power source. However, for practical reasons of heat dissipation, it is most common to attach the input or power source to the impeller which causes the entire coupling outer housing to rotate, thereby offering greater heat dissipation.

A typical slip curve for this type of coupling is shown in Fig. 3 (a) where the percentage of output slip is indicated for any input torque and speed within the limit of the coupling size.

In selecting a coupling to match any particular size of engine, it is necessary to impose the engine's torque curve on the above mentioned slip curve, then the performance characteristics can be drawn as presented in Fig. 3 (b). However, for a successful application, consideration of the required operating loads and speeds must be made in order that the coupling slip at continuous operation speed shall not exceed the capacity of the coupling to reject the heat generated due to slip.

Generally, the magnitude of continuous slip, which is allowable is in the range of 3 per cent to 4 per cent. Please note from the performance curve that the characteristics of the coupling are such that it allows the engine to start at practially no load and to come up close to its maximum torque before full load is imposed.

Since slip represents loss of power,

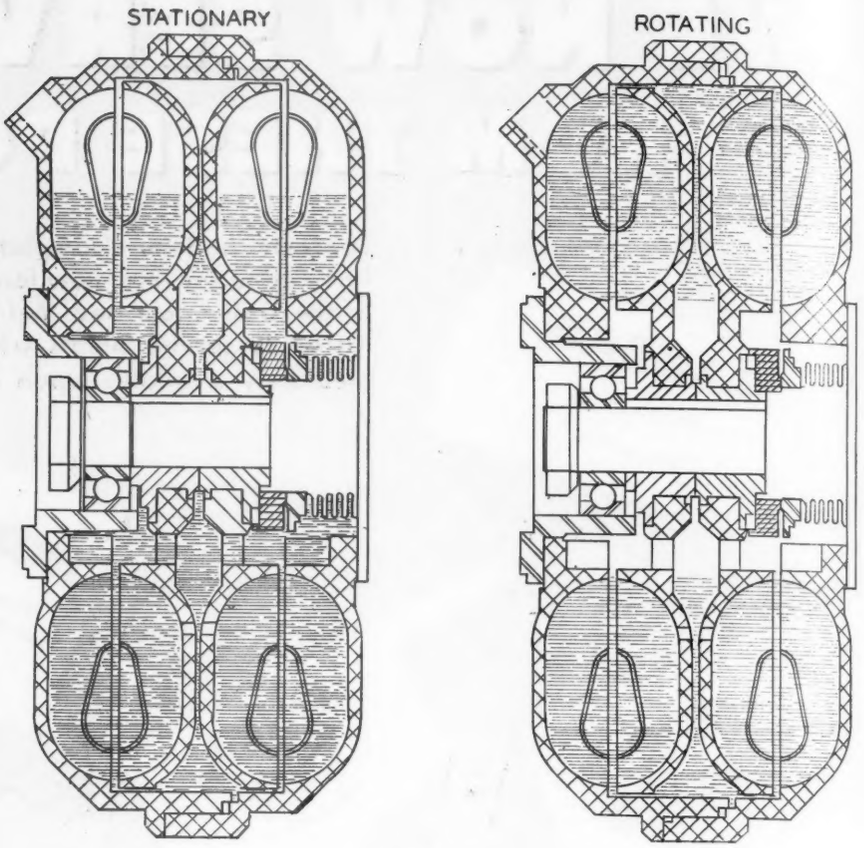
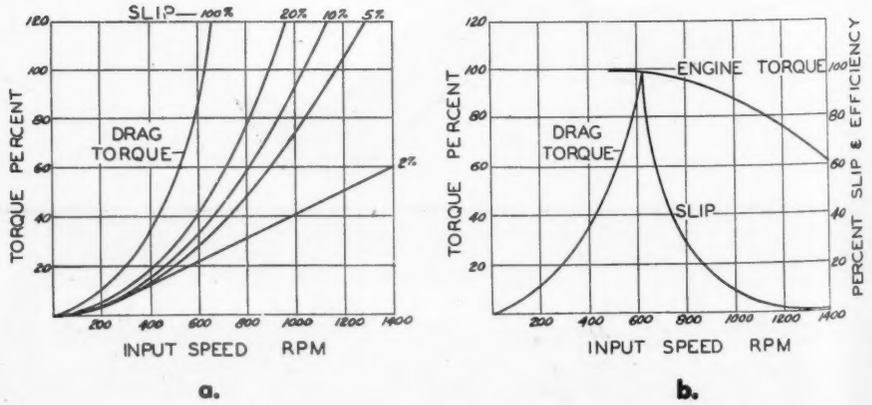


FIG. 2.

it must be more than justified by the following stated performance characteristics: First, a coupling provides protection to the driven unit as against torsional vibrations from the engine; second, it prevents shock loads from being transmitted back to the engine; third, it prevents engine stall and dampens shock from flywheel WR^2 when driven unit stalls; and fourth, it provides a means of starting heavy loads which would normally stall the engine or burn up the clutch before they could be brought up to running speed.

Oil field applications of the traction type coupling have been made on a wide variety of equipment, such as air compressors, servicing hoists, slim hole and water well rigs, pipe line wrapping machines, waterflooding pump drives, production pumping units, and electric motors. We can definitely expect to see a greatly increased number of applications of the traction hydraulic coupling in all

FIG. 3. Typical characteristic performance curves for traction type hydraulic coupling.



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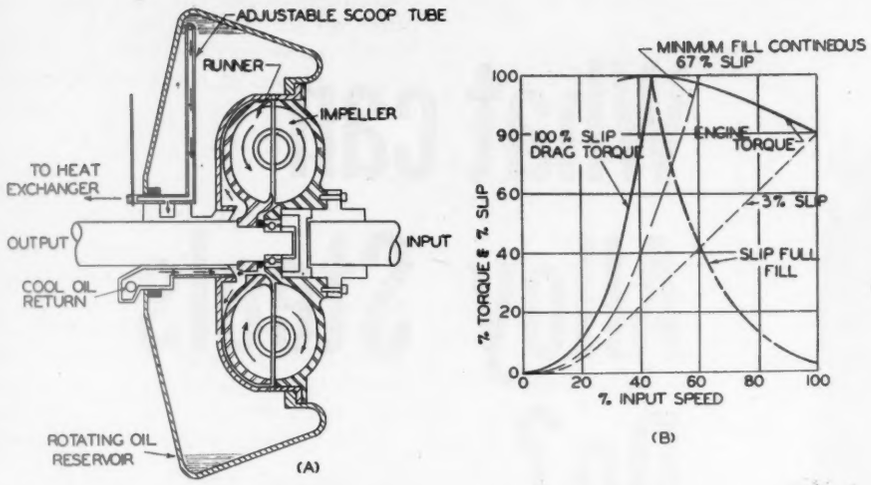

FIG. 4. Scoop tube type hydraulic coupling.

phases of oil field equipment manufacture, because of its low original cost, simplicity of application, and fool proof operation.

Variable Speed Coupling

The scoop tube, or variable speed coupling, is the simplest modification of the basic hydro-kinetic unit. Speed and torque variations are obtained through the use of a scoop tube which provides the means of changing the quantity of oil in the working annulus. As shown in Fig. 4 (a) when the scoop is set for maximum dip, the idle oil in the rotating housing is at a minimum and the working circuit of the coupling is full. Under this condition, the coupling performance is identical with the full-fill traction coupling and the output shaft will run at approximately 96 per cent to 97 per cent of engine input speed. However, when the scoop is lowered, the working circuit oil bleeds off through the orifices until a balance is established between the oil picked up by the scoop and the rotating storage oil level. If the scoop is fully lowered no oil enters the working circuit of the coupling and the oil in the circuit immediately bleeds out through the orifices. In this case, the coupling acts as a cutoff clutch which completely disconnects the load from the engine. The scoop tube coupling is the only member of the hydraulic unit family now being offered as a commercial product which affords this complete disconnect from the power source except, of course, by definite outside mechanical means. All other hydraulic units impose at least a minimum amount of drag on the output shaft even when the input shaft is turning at an idling speed.

By varying the amount of oil in the working circuit, speed and torque variations can be accomplished in the range of 3:1 ratio for speed and 5:1 ratio for torque. Since the speed variation within the coupling generates heat due to slip, the scoop affords a method of removing the oil from the working circuit and forcing it through an external heat exchanger. The cool

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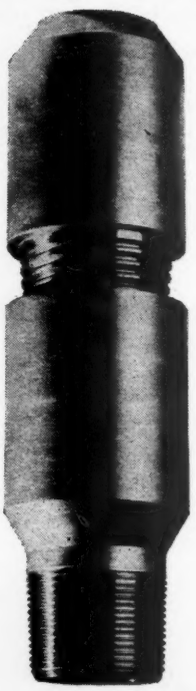

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oil is then forced into the circuit, thereby allowing for continuous operation even at a relatively high slip ratio. Oil field applications of the scoop tube type of hydraulic unit, to date have been limited generally to the larger power drilling rigs, mainly because of the initial investment required. Such applications, however, have proven entirely satisfactory and therefore additional installations can be anticipated.

Schneider Type Converters

The next logical division of kinetic hydraulic units is the Schneider single stage torque converter. This unit operates part of the time as a single stage converter and the rest of the time as a coupling, thereby offering some of the operating advantages of both.

Fig. 5 (a) shows a cross section of a typical unit in which there are three principal operational parts — the pump, the turbine, and the reaction member. All three parts are similar in construction and function to a single stage converter in so far as the pump is attached to the input shaft and the turbine to the output shaft. However, the reaction member differs at this point since it is mounted on a free wheeling clutch type bearing which is located between the pump and turbine. The reaction member is the part which makes torque multiplication possible, since it is locked in a stationary position during periods when output torque demand is greater than input torque. The force which accomplishes this alternate lock up and break away is supplied by the direction in which the oil strikes the reaction member blades. The break away point is also known as the clutch point.

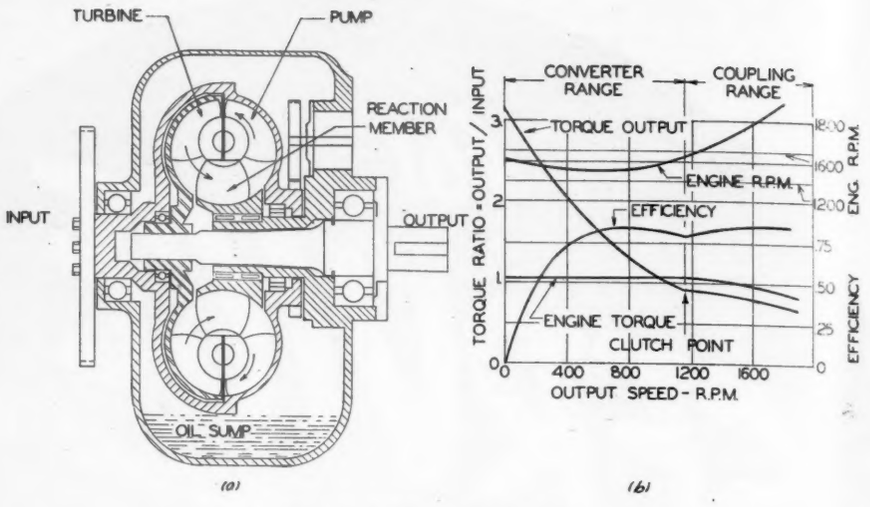

FIG. 5. Schneider converter.

Fig. 5 (b) represents a typical performance curve for a Schneider type torque converter. Kindly note that there are two ranges of operation: The converter range of torque multiplication and the coupling range of unit torque output.

The clutch point where the reaction member breaks loose and rotates with the turbine is generally located at a

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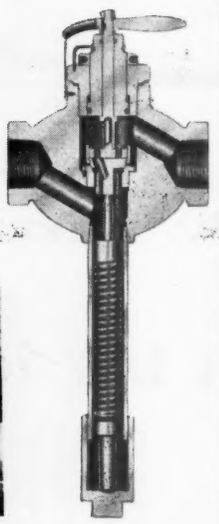

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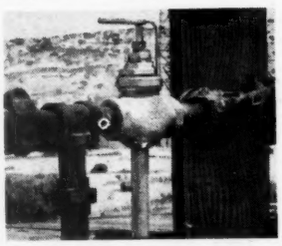

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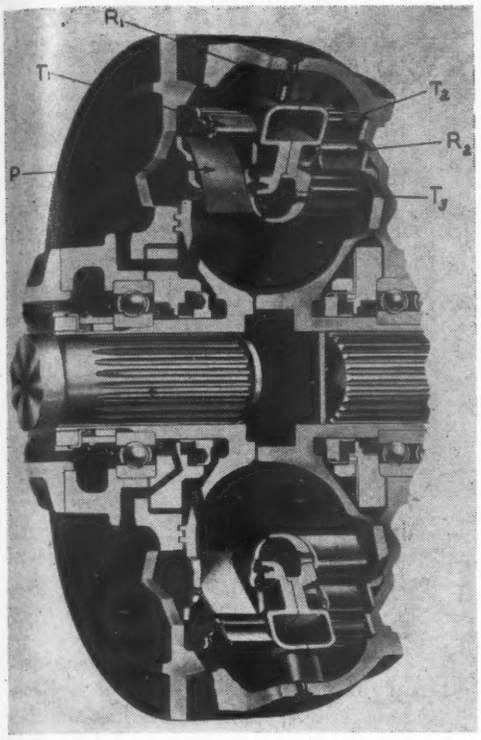
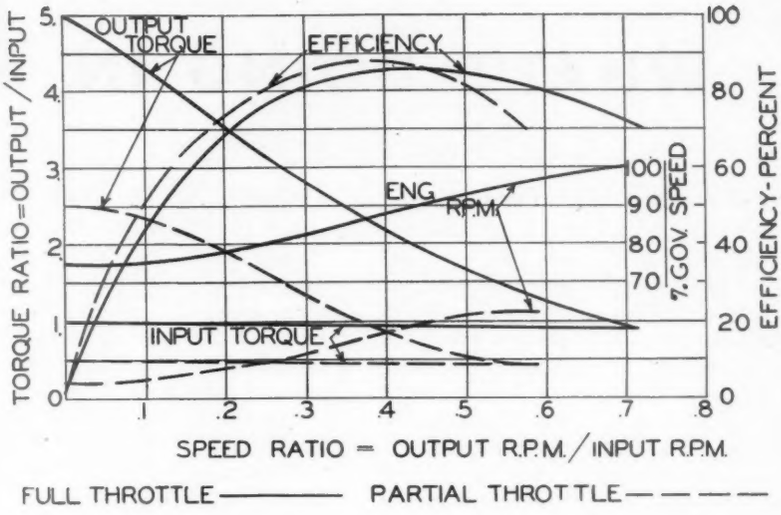


a.



b.

FIG. 4. Lysholm-Smith torque converter.

speed ratio of .8 for most industrial applications. However, by circuit design modification the clutch point can be moved down to as low as .5 ratio if desirable.

The converter may be called upon to operate for long periods of time at relatively low output to input speed ratios, thereby generating considerable heat due to turbulence, and for this reason it is necessary to continuously bleed off a portion of the oil in the circuit and force this oil through an external radiator or heat exchanger. The required capacity of the radiator or heat exchanger is dependent upon the application, and in some installations very little external radiation capacity is necessary.

To date, the Schneider converter has found most of its applications in the automotive and locomotive field. However, because of its performance characteristics, it undoubtedly will find its proper place in oil field equipment at an early date. Experimental oil field installations have been made on service hoists and rotary table drive units, and others are no doubt being contemplated.

Lysholm-Smith Converter

Of all the hydro-kinetic units, the Lysholm-Smith converter has the greatest overall torque multiplication. The hydraulic circuit of this unit consists of a single stage centrifugal pump discharging through a three-stage turbine, with two stages of reaction interposed behind the first and second turbine stages. Fig. 4 (a) shows the three basic parts; the pump which is a riveted fabrication of a hub, rim, and one set of blades indicated as (P); the turbine which is a riveted assembly of rims, shells, shroud, and three sets of blades indicated as (T1) (T2) (T3); and the converter housing or bowl, which is a contour machined casting in which two sets of reaction blades are riveted, indicated by (R1) (R2). All parts of the converter are meticulously machined to reduce fluid turbulence to a minimum. The blade cross sections are of the tapering air foil type and are set at an angle to the fluid flow, with the trailing edge sloping backward relative to the direction of motion. Circumferential labyrinth seals are used between stages to prevent fluid from by-passing the working circuit. The oil is constantly being heated due to turbulence which makes it necessary to continuously run a small portion of the oil in the hydraulic circuit through an external radiator or heat exchanger. The capacity of the radiator is usually designed to handle a maximum 30 per cent of input horsepower.

Fig. 4 (b) shows typical converter performance characteristic curves as powered by an engine. The full lines indicate full throttle operation and the dotted lines partial throttle operation. Maximum torque is developed at output stall and is approximately five times engine torque. Maximum efficiency of 85 per cent is attained at a speed ratio of approximately .5. Full throttle operation at low speed ratio, below the 70 per cent efficiency point, causes overheating, therefore the converter, for continuous duty, should be operated between .2 and .8 speed ratios.

Frequent intermittent operations outside this range are normal practice so long as they are spaced with ample time for cooling the unit. Partial throttle operation performance is very similar to full throttle performance except that it is reduced in magnitude, or speed.

In order to properly apply a converter to any engine and machine assembly, it is necessary to select the converter size so that full rated engine horsepower will be absorbed at a speed ratio of .7 to .8 and the drive ratios in the machine so designed that continuous operation occurs above the 70 per cent efficiency point.

Effective oil field applications of the Lysholm-Smith torque converter have been made on several sizes of heavy duty drilling rigs, slush pumps, cementing pumps, coring reels, workover rigs, servicing winches, bulldozers, independent rotary table drive units, special purpose pumps, and various other specialized applications.

* * *

Section 2 of this paper will begin in an early issue.

WHAT'S DOING IN DRILLING

New Kansas Oil Pool

El Dorado Refining Company and Flourney and Williams Drilling Company have established a new producing area 2 miles east of Ames pool in eastern Barton County and about the same distance southwest of Gemeinhardt pool in western Rice County, Kansas. Their 1-B Stumps, in Barton County, has been completed for a drawdown potential of 3000 bbl per day from Arbuckle lime, topped at 3283 ft. Production is from open hole at 3285-99 ft.

Large Ontario Gas Well

Imperial Oil Company has completed the largest gas well drilled in Ontario, Canada in 15 years. It is on the Roy W. Booth farm, one and one-half miles northwest of the Kimball gas field. The flow, from the Guelph-Niagara formation, is estimated at 15,000,000 cu ft of dry gas a day, with around 800 psi rock pressure.

Condensate Pool Found

A new condensate pool has been opened in Iberville Parish, Louisiana with the completion of Callery and Hurt's 1 Repp. The well flowed 414 bbl of 51.4 gravity oil plus 1,725,000 cu ft of gas per day. Production is through perforations at 10,890-27 ft and total depth of the well is 11,300 ft.

Records Set in Deep Well

In The Superior Oil Company's Pacific Creek No. 1, to date the world's deepest well, radioactivity well logging and jet* perforating services were successfully performed at the greatest depth in which either of these services have been used.†

Standard equipment was used throughout both the radio-activity well logging and perforating operations.

On July 1 a combination radioactivity well log (gamma ray and neutron survey) was run to a total depth of 19,743 ft. The area logged extended from 19,741 ft to 9500 ft.

On July 2nd, the record depth well was gun perforated by the jet process with 168 charges being fired below 13,000 ft. On July 6, 144 charges were fired below 14,000 ft; on July 10, 240 charges were fired below 15,600 ft; and on July 14, 200 charges were fired below 17,400 ft.

*Koneshot.
†Lane-Wells Company.

Saudi Arabian Production Down

Crude oil production in Saudi Arabia during July amounted to 12,431,050 bbl, or an average of 401,002 bbl per calendar day, it was announced by the Arabian American Oil Company. Daily average production was down some from the June report, which showed an average of 481,118 bbl per day.

Crude processed at the company's refinery at Ras Tanura amounted to 4,253,006 bbl, or an average of 137,194 bbl per calendar day. June's average was 148,943 bbl per day.

Crude oil production for the first seven months of 1949 amounted to 104,466,823 bbl, an average of 492,768 bbl per calendar day. Crude run in the refinery for the same period was 28,775,579 bbl, an average of 135,734 bbl per calendar day.

Extend Elk City Pool

Shell Oil Company, Inc., discoverer of the prolific Elk City pool in Beckham county, Oklahoma has another producer there that extends the field another mile to the west. Its No. 1 Oklahoma State "B" flowed 57.8 gravity oil at a rate of 1152 bbl daily on basis of a flow for 62 min through ½-in. bottom and ⅝-in. top chokes on the test from 9380-9472 ft. It is drilling at 9531 ft.

The new producer is a mile west of Shell No. 1 McKenzie. On the drill stem test, the well flowed the water load in 17 min, showed gas in 24 min, and started flowing oil in 34 min. With the oil was 4,550,000 cu ft of gas a day for a gas-oil ratio of 3940 to 1.

Pictures of an oil well fire at Standard Oil Company's Pacific Electric No. 37 well, at Huntington Beach, California. Left, the fire continues to blaze for the third consecutive day, when McCullough Tool Company service men were called in to use gun perforating equipment. One hundred and eighty holes were shot in an adjoining well, center, 100 ft away, at a depth of 2500 ft for the purpose of flooding the burning well. Water was injected, and a few hours later the fire was extinguished. Right, workmen lowered pack-off assembly into place bringing well under complete control.

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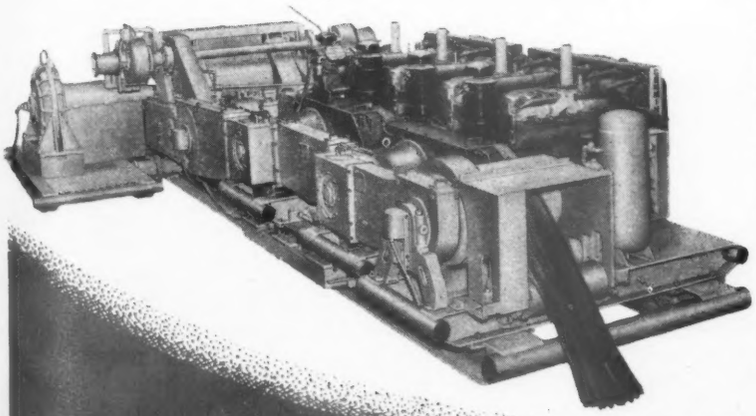

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1949 Drilling Activity Paces 1948

The number of active drilling rigs operating in the United States and Canada during the first seven months of 1949 averaged 2092 per month, or 3 more per month than for the same months last year.

Leaders in the drilling industry expect rig activity to increase during the balance of the year. They point to the fact that the peak in the number of active rigs for the past six years has come in November or December of each year. The peak of 2437 rigs for 1948 was in November; a top of 2056 rigs was established in the same month of 1947, while in 1946 the peak of 1700 rigs was reached in December. The low point in rig activity has generally been in the summer months.

Extends Rita Field

Humble Oil and Refining Company has completed its No. 3, Mrs. S. K. East, in the Rita area, Kenedy County, Southwest Texas. On initial test the well flowed 43 bbl of 47 gravity oil per day with 250 psi pressure on the tubing. Total depth of the well is 9708 ft, and production is through perforations at 5122-32 ft.

Extends Sharon Ridge Reef

Cities Service Oil Company has given the Sharon Ridge pool of Scurry County, Texas, another producer. The company completed its Pearson No. 1 for 1456-bbl, providing the southernmost producer for the field from the Canyon reef lime formation. The well is producing 42 gravity oil.

Rapid Development Seen

Rapid development of the new Prasifka oil field in Wharton County, Texas, is indicated.

C. C. Gilger, Houston, Texas, discoverer of the pool, has made location for No. 1 Fannie C. Porges on a 20-acre tract, 740 feet south of the discovery well.

The discovery flowed 175 bbl of 24.9-gravity oil daily through a 3/16-in. choke from 5548-54 ft.

Gets Second Producer

Cities Service Oil Company (Delaware) has completed its Balfour No. 1 to provide the Red Springs area of Smith County, Texas with its second commercial producer. The Balfour well is an offset to Humble's discovery and was completed for a potential of 229 bbl of oil daily through 17/64-in. choke.

Production is from the Rodessa lime, topped at 9182 ft. The Cities Service well is owned jointly with Eugenia F. Laster and E. C. Laster.

To Drill Kuwait Wells

The Brown Drilling Company of Long Beach, California and an Oklahoma City organization have been assigned the contract to drill wells already programmed in the Kuwait neutral zone on the Persian Gulf, it has been announced.

The president of the company, E. C. (Ned) Brown said most of the crews will be made up of men active in Arabia in recent months. Equipment and machinery has been assembled for shipment across the ocean around September 15.

Drill 10,000 ft in 47 Days

Helmerich and Payne, Inc., contractors and producers in Tulsa, Oklahoma, have set a drilling time record in West Texas at their Warren Wright-W. C. Chancellor No. 1, A. W. Daugherty survey, on the southwest side of the Benedum field, in Upton County. Spudded on April 9, it passed the 10,000-ft mark on May 25. The 7-in. casing has been run and cemented since that time at 11,525 ft, and completion operations begun. The total elapsed time for drilling to 10,024 ft was 1128 hr, or 47 days, figured on a total complete day basis.

Extends Mississippi Field

Stanolind Oil and Gas Company's J. B. Dockery No. 1, a wildcat near the Russum field, Jefferson and Claiborne counties, Mississippi, flowed about 248 bbl of oil per day through 24/64-in. choke. It was closed down while additional storage was erected, and when reopened, it flowed 13 bbl of oil in 1 hour through 16/64-in. choke, but pressures dropped rapidly, and the well died 1 hour and 15 min after being opened. Steady flow through a small choke has not yet been obtained.

Three Wells Showing In Garvin Pool

Three major oil companies have wells showing for producers in the New Hope pool in Garvin County, Oklahoma. Texaco has completed the No. 1 Brown-B, which was drilled to 7155 ft. Seven-inch casing has been run to 7126 ft, and plugged back to 7090, before perforating with 88 holes at 6922-44 ft. On initial test, it flowed 35 bbl of oil in five hours through a 16/64-in. choke. Oil was 42-gravity and showed a gas-oil ratio of 1080-1.

Continental Oil has shut in to erect tankage at the No. 1 Holdsclaw-Ross, after flowing 125 bbl of oil in seven hours through a 20/64-in. choke.

Carter Oil was to perforate more zone at the No. 1 Hall-Sanford, after flowing 33 bbl of oil in six hours from a 1-ft perforated section at 6948-49 ft.

Questions & Answers

about the many unique features in the Shaffer Combination Rotating Blowout Preventer and Stripper

BECAUSE IT is so complete, so adaptable, so trouble-free in all types of pressure control operations, operators everywhere are asking for more information about the Shaffer Type 46 Combination Rotating Blow-Out Preventer and Stripper. Typical questions include . . .

"DOES IT REQUIRE SPECIAL STRINGS OF PIPE? *We like to simplify our operations and inventories as much as possible and are wondering if your unit requires flush joint or other special pipe."*

NO! The Shaffer Type 46 Combination Rotating Blow-Out Preventer and Stripper requires no special drill string equipment of any kind. It packs off around *any* type of pipe—coupled, upset or flush—with equal efficiency and safety. What's more, it maintains its leak-proof seal *continuously* while any type of pipe is raised or lowered through the unit!

"WHAT OPERATIONS ARE NEEDED TO PACK OFF THE UNIT? *Pressure emergencies happen fast. What operations are required to seal-off against pressure leakage around the drill string?"*

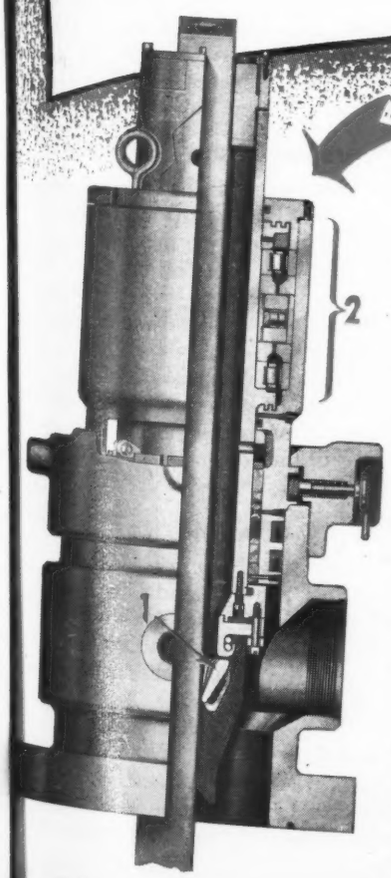
NONE! The Shaffer Type 46 Combination Rotating Blow-Out Preventer and Stripper is *always* packed off while the drill string is in the hole. No matter how sudden the pressure emergency, it can't be too fast for the Shaffer Preventer *because no operations whatever are needed to place it in operation!*

"CAN BITS AND REAMERS BE PASSED THROUGH THE UNIT *with maximum ease, safety and simplicity?"*

DEFINITELY YES! Just pull a latch, rotate the Bonnet 1/6th turn and the entire internal mechanism rides out on top of the bit or reamer. Simply reverse the operation when going back into the hole. It's as easy as that—*and as quick!*

"HOW ABOUT THE KELLY? *Is a special kelly needed to keep from damaging the sealing rubber?"*

NO SPECIAL KELLY IS NEEDED with the Shaffer Type 46 Combination Rotating Blow-Out Preventer and Stripper. You can use a square, hexagon or octagon kelly—whichever you prefer—and the *same* unit seals as effectively around each type. What's more, because the Stripper Rubber rotates *with* the kelly—not around it—there is virtually no wear on the Rubber while drilling. Cuts maintenance, assures better pack-off and a maximum of trouble-free safety!



. . . and note these features

There are many other unique advancements incorporated into the Shaffer Type 46 Combination Rotating Blow-Out Preventer and Stripper of which the following are typical . . .

1. EXPANDABLE STEEL BARRIER PROTECTS RUBBER. Note how the Stripper Rubber is protected by a barrier of steel latches that expands and contracts to permit normal flexure—but safeguards against extrusion or abnormal expansion.

2. ADVANCED BEARING DESIGN. Thrust and radial loads are carried on separate bearing assemblies, each specifically engineered for its particular type of service. In addition, the radial bearings are widely-spaced to provide ample resistance against wobble and gyrating loads.

These and still other unique advancements make the Shaffer Type 46 Combination Rotating Blow-Out Preventer and Stripper the most *efficient*, most *versatile*, most *positive* pressure control unit yet developed. Get *all* the details on this years-ahead control unit from your Shaffer representative. Or write

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EXPLORATION ACTIVITIES

Test Louisiana Wildcat

Atlantic Refining Company is testing at its No. 1 Albert Meche, wildcat four miles northwest of Shuteston, St. Landry Parish, Louisiana.

The well was drilled to 9898 and initial test from 9502-06 recovered some oil and gas. These perforations were squeezed and operator now is testing at 9474-82 ft.

Opens New Pay

Shell Oil Company Inc., has opened another pay zone with its No. 1 Oklahoma State "B" in the Beckham County, Oklahoma, sector of the Elk City field. On drill stem test between 9546-646 ft with ½-in. bottom and ⅝-in. top chokes, the well flowed at a rate of 1040 bbl of 61 gravity distillate a day during the last 25 min of the test. Previously, on test between 9380-9472 ft, the well had flowed at a rate of 1152 bbl of 57.8 gravity distillate on basis of a 62-min flow.

The well extended the field another mile to the west. It was bottomed at 9646 ft at the time of the test.

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Movie stars Bob Hope and Bing Crosby are in the oil business as a result of favorable tests made in Scurry County, West Texas. A well in which they hold an interest with W. A. Moncrief, Fort Worth, Texas, and Paul Teas, Dallas, Texas, showed for a flush producer to extend the North Snyder Canyon reef field nearly two miles southeast.

The well, No. 1 C. W. Huckabee, five miles north of Snyder, flowed at the rate of 100 bbl of oil an hour on a drill-stem test at 6680-800 total depth. On the test, gas showed to surface in 5 min and oil in 15 min.

New Kansas Strike

A new strike in Stafford county, Kansas, holds promise of being one of the major oil finds of the year in Kansas. It is the W. L. Hartman, H. S. McClintok, and Robert R. Murray's No. 1 Jordan, two miles east of the Jordan pool. After drilling to 4132 ft in the Arbuckle, operators plugged back to the Lansing lime and perforated casing at 3520-28 ft and applied 500 gal of acid. The well started swabbing at the rate of 22 bbl of oil per hour. The oil tested 41.6 gravity.

Wildcat Venture Proves Successful

The Texas Pacific Coal and Oil Company of Fort Worth, Texas, has reported that its first wildcat venture in Kansas has proved successful. The firm said its No. 1 Gabrielson in McPherson County, seven miles east of the Lindsborg pool, was completed at 3571 ft as a discovery well for 107 bbl of 30-gravity oil daily. Texas Pacific is now drilling a second wildcat in Kansas, the No. 1 Peterson, 3½ miles south of the discovery well.

Opens New Field

A new field is being opened in the Denver-Cheyenne basin of Laramie County, Wyoming at The California Company's No. 1 Morton-King, with pay from the Muddy sand zone.

Drilled to 11,374½ ft to get granite, pipe was cemented at 8760 ft and perforated at 8540-65 ft, where the well swabbed six barrels of oil an hour. On first test the well flowed 162 bbl of oil in 16 hours through a ⅜-in. choke, later on a 11½-hr test it flowed 121 bbl of oil through a ⅜-in. choke.

Opens Deepest Canadian Pool

Canadian Gulf Oil Company's Walter Marr No. 1 has confirmed a major wet gas field in the Pincher Creek area. The Marr 1 is not only Canada's deepest producing well (12,473 ft) but also the largest wet gas well ever completed in the Dominion, with a calculated potential of 83,000,000 cu ft of gas and 3000 bbl of 52½ gravity oil per day. Total depth is 12,768 ft.

New Montana Pool

Additional production tests have been made by British American Oil Company at its No. 1 McClellan-Government, pool-opener at Clark's Fork in Carbon County, Montana. The well was drilled to 9446 ft and plugged back to the Dakota at 7548-60 ft.

Tested against 400 lb back pressure the well gauged 2,628,000 cu ft of gas and 65 bbl of condensate in 24 hours. The condensate tests 65.4 gravity.

Illinois Well Completed

Magnolia Petroleum Company has completed its No. 1 Burgess in Wayne County, Illinois. Situated south of the discovery well, this new producer flowed 2807 bbl natural in the first 24 hours, and increased its output to 2863 bbl in the second 24 hours. Pay is the McClosky lime at 2980-87 ft. The well is in the area north of Orchardville in Wayne County.

Discovers Louisiana Gas Field

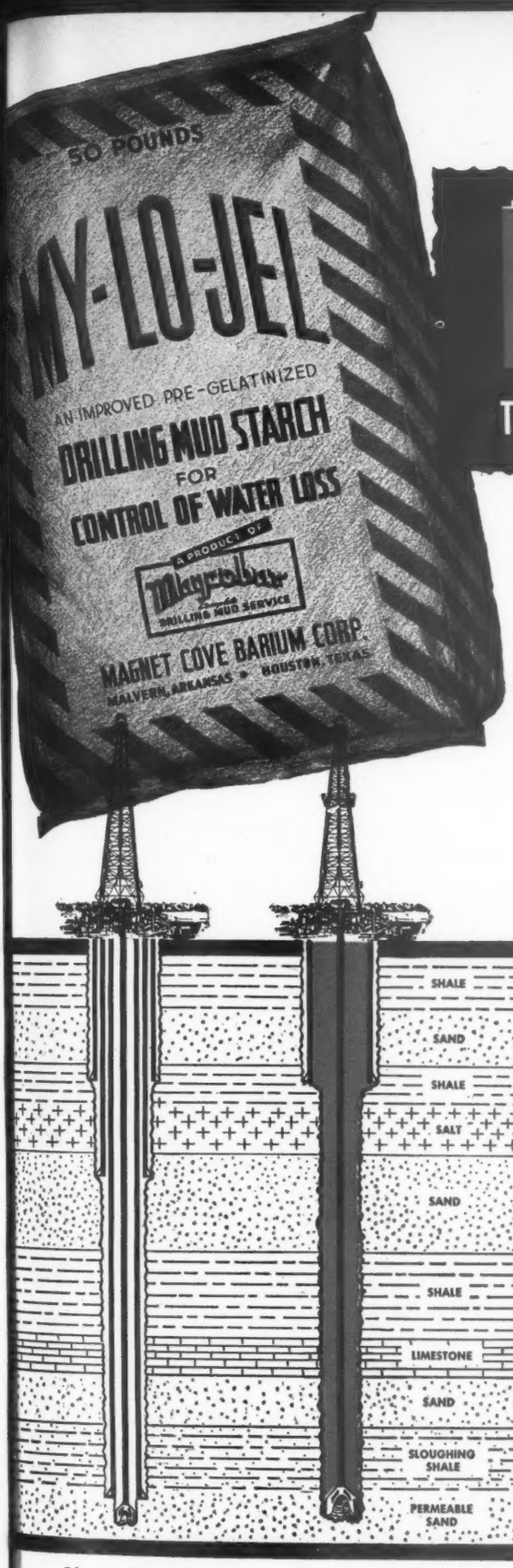
Announcement has been made by Continental Oil Company of the discovery of a prospective new gas-condensate field with completion of No. 1 R. A. Estes, wildcat in Jefferson Parish, Louisiana, about three miles northeast of Welsh.

The well made 126 bbl of 44-gravity condensate in 18 hours on a 11/64-in. choke, after being perforated at 11,263-67 in the lower Miocene. Gas-oil ratio was 28,571 to 1.

Testing in New Mexico

A 2000-ft test 12 miles southwest of the Black River field, in Eddy County, Southeast New Mexico, will be drilled by the Carper Drilling Company. It will be No. 1 Gates in Sec. 34-25S-25E.

Shell Oil Company has staked an Ellenburger test as No. 1 W. V. Lawrence, Sec. 13-17S-39E, Lea County, contracted to 13,000 ft. The wildcat is about six miles northeast of Hobbs.



The well on the left is an example of where two additional strings of protective casing were necessary — one to protect a zone of rock salt and the other to protect a sloughing shale. My-Lo-Jel Mud eliminated the necessity for this extra casing.

MY-LO-JEL

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Quick acting, tough, economical My-Lo-Jel provides positive control of filtration properties.

Magcobar My-Lo-Jel is an improved pregelatinized drilling mud starch in the form of a free flowing powder which can be added directly to the mud through a hopper mixer. My-Lo-Jel provides positive control of the filtration properties of mud even in the presence of salt, anhydrite and other contaminants. It is a blended starch that is especially processed to produce a quick acting, tough and chemically stable plugging agent to inhibit filtration of mud. Thus, it not only lowers water loss, but keeps it low.

My-Lo-Jel is economical and easy to use. So why take chances with tight holes due to filter cake when low water loss muds made with My-Lo-Jel can hold down the cost of drilling by eliminating strings of protective casing, preventing delays due to reaming, hole trouble and fishing jobs.

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DRILLING MUD SERVICE

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California Test

Richfield Oil Company is drilling a new test well in the Casmalia area of Santa Barbara County, California. The well, called Soladino No. 52 is drilling the shallower formations.

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Stake 3000 ft Test

Deep Well Oil Corp. of Fort Worth, Texas, is moving in tools for a 3000-ft wildcat test on its No. 1 Charles Walls, in southern Pottawatomie County, Oklahoma. Nearest well drilled to the location is a 3600-ft test on the Messer lands, abandoned in December, 1934. Situated on the Corrine anticline, the original geology was by the USGA, and recently was worked and rechecked by A. L. Walker, Jr. This area was also included in a broad core-drill and seismograph survey made more than 20 years ago by Marland Oil Company.

Tests Show Good Flow

A good producer may be found in the East Lindsay pool in Garvin County, Oklahoma. Barnsdall Oil Company and Sinclair Oil and Gas Company's No. 1 See-Smith flowed oil at a rate of 35 bbl an hour on a drill stem test between 9140-9217 ft in the Chimney Hill section of the Hunton lime. Gas production was 2,000,000 cu ft a day. The well will be carried to the Bromide, and is drilling at 9251 ft.

Test Coke County Wildcat

Oil recovery has been obtained on a formation test made at a Coke County, Texas wildcat. Barnsdall Oil No. 1 Davenport, 475-Clark, tested for two hours and 15 min at 5500-541 ft. The well showed gas in 8 min, estimated at 200,000 ft daily. Recovery was 80 ft of mud, 1060 ft of 42-gravity oil and 540 ft of salty water. Earlier the well got 1000 ft of oil and 300 ft of water on a 90-min test at 5375-93 ft.

Gas Well Drilled In Arctic Basin

Natural gas has been found in commercial quantities in the Arctic Basin of Naval Petroleum Reserve No. 4. The natural gas well, known as "South Barrow No. 2," has been drilled about six miles south of Point Barrow, Alaska. Pressures and production performance indicate a considerable deposit of gas.

"This discovery, plus the 'shows' of oil and gas tested in wells drilled in other parts of the Reserve, justify the exploration program being conducted by the Navy in Alaska," according to Commodore William G. Greenman, U.S.N. The South Barrow No. 2 well is now flowing gas in sufficient quantities to meet the fuel requirements of the Naval installations at Point Barrow. All of the five deep wells drilled to date, and two of the three now being drilled, have revealed "shows" which encourage belief that commercial oil fields exist in the region.

The first test well, "South Barrow No. 1," was abandoned as a dry hole although it found enough oil and gas shows to warrant the drilling of South Barrow No. 2, the discovery well.

Colorado Discovery

R. E. Havenstrite may have a new field in Routt county, Colorado, at his No. 1 Ryles on the Oak Creek prospect in the southern part of the county. After getting 5800 ft of clean oil on drill-stem test, operators set pipe and are installing pump.

Total depth of the wildcat is 6747 ft, with the lower Morrison sand zone at 6671-99 ft, where the drill-stem test was made. Oil tested 34 gravity and is black. Seven-inch casing has been cemented at 6644 ft. Elevation is 9000 ft above sea level, making it one of the highest producers in the country.

Issue Geological Digest

The Tulsa Geological Society has published its 17th annual Digest, edited by John C. Maher of the U. S. Geological Survey and managed by V. L. Frost of the Ohio Oil Company.

This volume of 196 pages and 32 illustrations contains 23 digests of papers on foreign and U. S. regional and local geology, geophysics, photozeology, and exploration policies. Papers on the Velma, Ceres, Sholem Alechem, and Northwest Sulphur pools of Oklahoma, the Lawson-Chapman area of Texas, and the Anadarko Basin of Oklahoma and Kansas are included.

A directory of members listed both by name and company affiliation is appended to the text.

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Eastman Opens Houston Office

Opening of the new Gulf Coast division office of the Eastman Oil Well Survey Company at 2100 Old Spanish Trail, Houston, was celebrated July 30, with an open house for prominent oil industry officials.

Many modern architectural features are incorporated in the new office layout, which consists of three buildings, a whipstock rack, and large parking area. The office building, a one-story structure with a 90-ft frontage, has solid concrete floors, and the flat-deck roof has three-foot overhanging eaves. Facing on the structure is brick veneer of imitation adobe design, in a light green shade, with the entrance-way of cocoa color. Running across the entire front are windows of the new "Solox" tinted glass, designed to keep out 80 per cent of the heat and glare. Twenty-foot flower boxes, made of Roman brick, are situated on either side of the entrance. The general office, reception lobby, four private offices, conference and drafting rooms make up the plan of this building.

All walls and ceilings in the structure are fibre-glass insulated, making them moisture and vermin-proof. A 10-ton G. E. air conditioning plant will afford comfortable working conditions at all times.

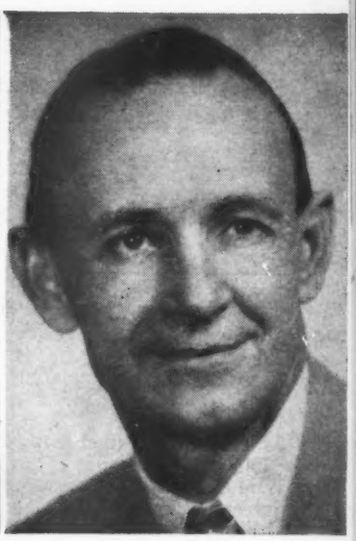
The welding, machine, and instrument shops are located in a 40 by 100 ft pre-fab steel building, that also houses the warehouse section. A 5-car garage for company cars is also located on the property.

Completion of the new Houston building ended a 15- year tenure of the Eastman Company at 4909 Fannin Street, where the Gulf Coast division office was first established in 1934. Extensive remodelling and modernization of the facilities has taken place since that time, to keep pace with the needs of the company's expanding activities, however, the need for larger quarters has been felt for some time.

Headquarters for the Gulf Coast division of the Eastman Oil Well Survey Company, the Houston office is home base for some 40 employees. In addition, branch offices at Brookhaven, Mississippi; Houma, Lafayette, and New Orleans, Louisiana; Victoria, Longview, and Alice, Texas, come under the jurisdiction of the Houston office.

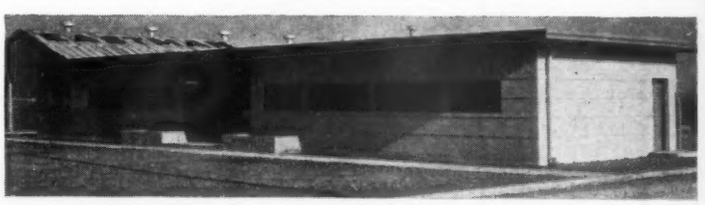
On hand to greet the oil industry guests at the company's "house-warming" celebration were William G. James, Gulf Coast division manager and a vice president of the company; W. H. Cook, division sales manager; and J. C. Staton, Gulf Coast field superintendent. Out of town Eastman officials at the party included H. John Eastman, president; Gordon Jackson, vice president and general manager; and Bud Hilker, director of public relations, all of Denver, Colorado.

H. John Eastman,
founder and president, Eastman Oil Well Survey Company



William G. James,
Gulf Coast division manager and vice president

E. W. Berlin, manager, production department, Standard Vacuum; H. L. J. Hunter and R. L. Greenham, Australasian Petroleum Company; W. B. Colvin, Magnolia Petroleum Company, and William G. James.



The new Gulf Coast Division Office of the Eastman Oil Well Survey Company at 2100 Old Spanish Trail in Houston, Texas.

I. W. Alcorn, division production engineer, Pure Oil Company; Bud Conley, general manager, Culp Engineering Company; M. F. Clegg, Meredith, Clegg and Hunt, drilling contractors, and Gordon Jackson, vice-president and general manager.

Russell Lewis, Hughes Tool Company; William G. James, and L. T. Tighe, assistant manager, production department, South Texas Division, The Texas Company.

DRILLING AND PUMPING EQUIPMENT

Steel Used and Annual Requirements for Drilling

(Study based on 2000 rotary rigs in operation—1947)

(Tons of 2,000 lb)	Weight per unit (tons)	Total in use for 2,000 rigs (tons)	Annual requirements (tons)	Annual per cent new and replacements
Draw works, complete	26.0	52,000	6,240	12
Traveling block	2.5	5,000	650	13
Swivel, hooks and elevators	3.5	7,000	1,050	15
Rotary	3.0	6,000	720	12
Kelly (4¼" sq)	1.2	2,400	1,944	81
Subs (connections) (6)	0.8	1,600	1,440	90
Pumps (incl sheaves)	12.0	24,000	3,120	13
98′ steel derrick (incl crown block)	18.5	37,000	4,440	12
Wire line (1350′)	1.5	3,000	5,790	193
Sub-structure	6.0	12,000	1,440	12
Drill pipe	41.5	83,000	51,286	62
3½ inch	8.5	17,000	12,410	73
4½ inch	24.9	49,800	29,880	60
5⅝ inch	4.4	8,800	3,520	40
Other sizes	3.7	7,400	5,476	74
Tool joints	8.0	16,000	8,480	53
Drill collars	6.0	12,000	9,360	78
Rock bits (avg 20 at 150#), incl holders and cutters	1.5	3,000	18,000	600
Fish-tail and drag bits (avg 10 at 60#)	0.3	600	1,440	240
Other equipment	10.0	20,000	4,000	20
Incl tool house, water pump, light plant, shale shaker, tongs, tool box, blow-out preventer, centr pump, core bit, etc				
Total	142.3	284,600	119,400	42

Casing Used in Wells Completed in 1947

(Based on 24,650 wells, including producing, service, and 10% of dry holes)

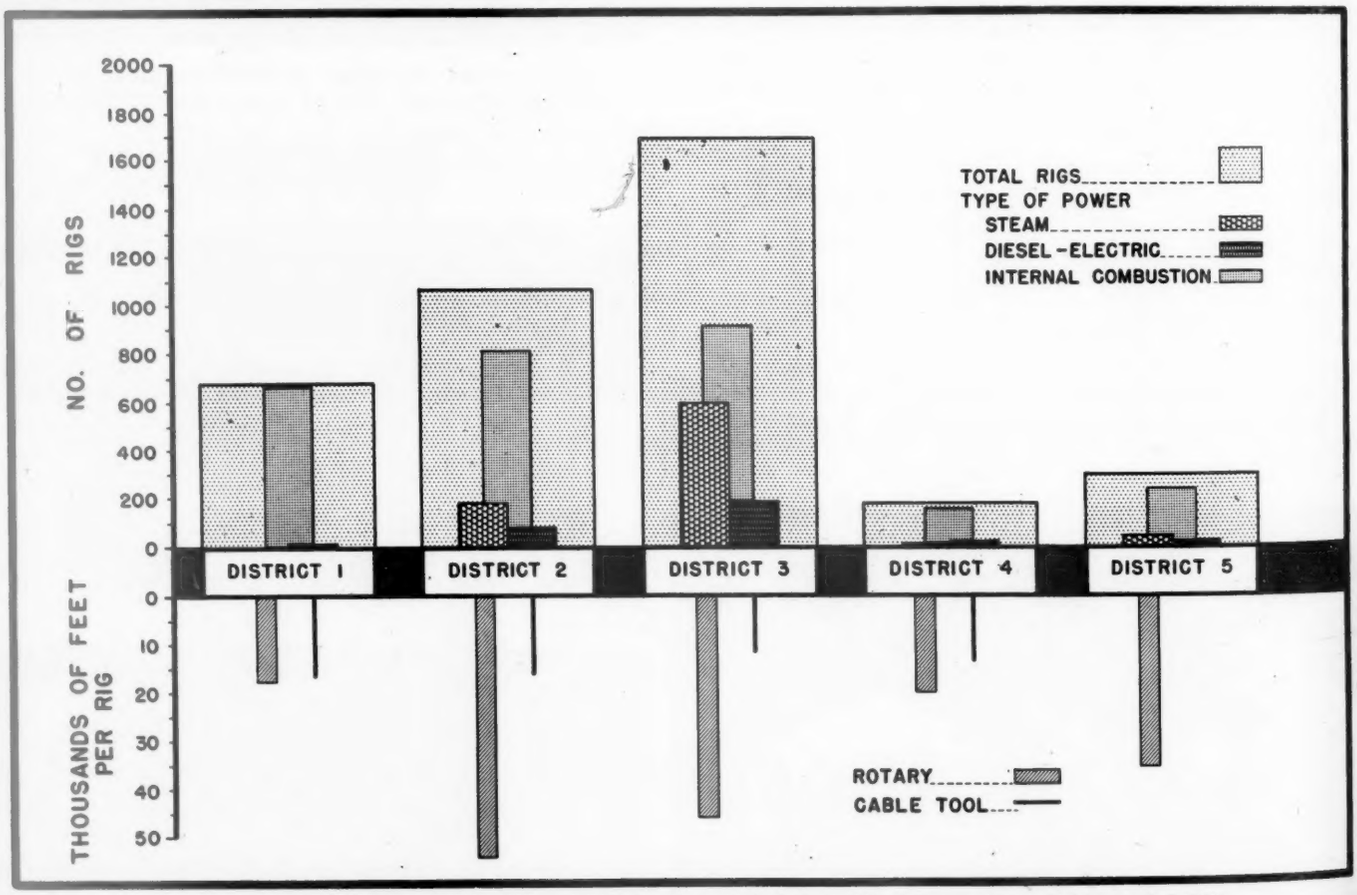
Size of casing (inches)	Use	Average weight per foot (lb)	Average number feet per well	Average weight per well (lb)	Total tons for 24,650 wells
4½, 5, 5½, 6,	Oil stream	15½	1,820	28,210	347,688
6⅝, 7, 7⅝,		24	1,380	33,120	408,204
8⅝		32	200	6,400	78,880
9⅝, 10¾, 11¾	Intermediate	40	320	12,800	157,760
13⅜, 16, 20	Surface	57	80	4,560	56,202
			3,800	85,090	1,048,734

Tonnage of Sucker Rods in Use and Annual Requirements

(Based on 372,600 pumping wells Jan. 1, 1947, with net increase of 7,200 new pumping wells during 1947)

Diameter of rods (inches)	Wt/ft rods and couplings (lb)	For 372,600 pumping wells: Total in use (tons)	For 372,600 pumping wells: Annual replacement (tons)	Annual requirement for net 7,200 new pumpers (tons)	Total annual replacements and new requirement (tons)
⅝	1.12	236,787	11,559	2,016	13,575
¾	1.62	241,445	16,329	8,748	25,077
⅞	2.25	62,969	4,815	2,025	6,840
1	2.88	8,011	306	518	824
Total		549,212	33,009	13,307	46,316

Source: *The Petroleum Data Book* Research Department.



71 per cent of rigs operated by internal combustion engines (see Rig Survey, pages D-16 and D-18).

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

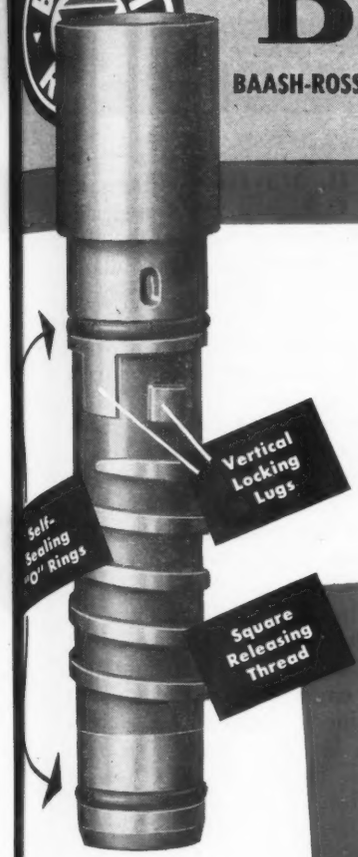
Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 29th YEAR

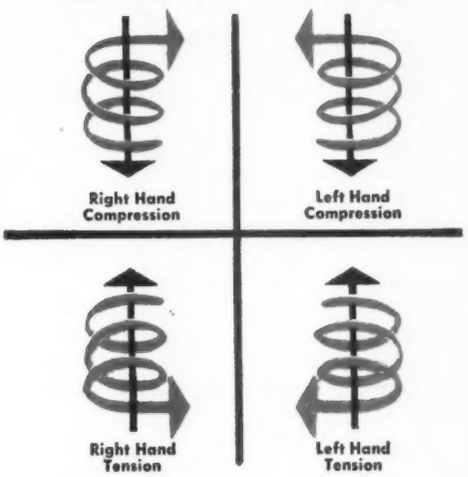
ANOTHER NEW BAASH-ROSS PRODUCT!

A simple, positive way to REMOVE STUCK TUBING STRINGS FROM YOUR PRODUCING WELLS



BAASH-ROSS PRODUCTION SAFETY JOINTS

4 TYPES TO MEET EVERY PRODUCTION REQUIREMENT



Why run the risk of costly salvage operations every time stuck packers, sanding conditions or similar difficulties jeopardize recovery of your tubing string, when it costs so little to insure recovery by using Baash-Ross Production Safety Joints?

A Baash-Ross Production Safety Joint placed in your tubing string provides a positive means of freeing the string at the point where the Safety Joint is installed, thus permitting important savings to be made in production operations. For example . . .

- **Where production packers are used, a Safety Joint should be installed above the packer to permit positive and complete release of the tubing string should the packer become stuck.**
- **Where sanding conditions exist, one or more Baash-Ross Production Safety Joints should be installed in the tubing string to permit selective release and maximum recovery.**
- **Where it may be desirable to change production methods in a well, a Baash-Ross Production Safety Joint should be installed in the tubing string to permit such changes to be made quickly and easily without disturbing the packer.**

Baash-Ross Production Safety Joints are simple in design, positive in operation and low in cost. They are provided with a unique locking lug that permits heavy rotational loads to be transmitted through the Joint without loosening it—yet disengagement can be quickly made whenever desired by merely following a simple sequence of operations. A choice of *four* different releasing actions is available—either *left* or *right* hand rotation, combined with either *raising* or *lowering* the production string—thus providing the exact releasing action best suited to each production hook-up.

LEAK-PROOF SEAL . . . FULL OPENING PASSAGE

Note in the illustration how the Baash-Ross Production Safety Joint is packed off top and bottom with self-sealing "O" rings to permit circulation through the Joint without leakage. Also, the Joint is full-opening so that rods, tools and clean-out equipment can be passed without difficulty. In fact, the Joint has the same internal and external diameters as the production string itself. Anything that will pass through the tubing string will pass through the Joint . . . and the Joint itself will pass through anything the tubing couplings will pass through—an important consideration when used with certain types of suspensions.

A Size For Every Production Need

Baash-Ross Production Safety Joints are made of heat-treated alloy steel and are available in all four releasing actions to fit all sizes and types of API Tubing. So no matter what the nature of your particular production operations, you can protect against costly recovery or conversion operations by placing one of these efficient Joints on every tubing string.

QUICK POSITIVE RELEASE

Here's how the Baash-Ross Production Safety Joint operates to protect your tubing strings. The Joint consists essentially of a box and pin releasing thread (either right or left hand, as ordered) that is packed off top and bottom with self-sealing "O" rings. In the upper portion of the pin thread, two vertical lugs are machined into the body, and these lugs mate with a corresponding lug machined into the box portion.

The releasing threads are cut with a loose fit—that is, when the Joint is made up, the two portions can move a short distance longitudinally with respect to one another without affecting the vertical alignment of the Joint. This movement permits the mating lugs to lock and unlock as one portion of the Joint is moved with respect to the other portion—and the design of the lugs determines whether the Joint unlocks in tension or in compression. A shear pin is also provided that permits longitudinal movement of the Joint, but prevents premature rotational release.

Basically, the releasing action consists of first unlocking the lugs by lowering (or raising) the string—then rotating the string in the proper releasing direction (either right or left) to sever the shear pin and unscrew the Joint. Only by first moving the string in the proper vertical direction, then rotating it in the correct releasing direction, can the Joint be disengaged—and by properly selecting the releasing action, other tools below can be set and released without risk of disengaging the Joint.

running tour with men in the industry

▸ Humble Oil and Refining Company has announced the following transfers and promotions of supervisory personnel in the production department:

S. E. Wallette, district superintendent at Hub, Louisiana division, was transferred to the Sunniland district, replacing R. B. Gustafson. Gustafson was transferred to the Eucutta district as district superintendent.

C. K. Seaman, assistant district superintendent at Sunniland, has been transferred to the Wink district in the West Texas division.

Robert L. Mills, assistant district superintendent at Galveston Bay, was transfered to the petroleum engineering division in the Houston office for work as supervising engineer.

Paul L. McGee, assistant district superintendent of the London district, was transferred to Goose Creek as district petroleum engineer.

J. F. Richie, assistant district chief was transferred from the Eucutta district to the Houston Gas Construction division.

James W. Roark, assistant district chief clerk of the North Katy district, was transferred to the marine equipment division in the Houston office.

John C. McDuffie, former associate petroleum engineer, was transferred from the East Texas division office to the petroleum engineering division in Houston for work as petroleum engineer.

M. M. Porter has been placed in charge of the Houston warehouse as district chief clerk, replacing J. N. Smith. Smith was transferred to the material distribution section, Houston office.

▸ **Kenneth L. Smith,** formerly a petroleum engineer in Stanolind Oil and Gas Company's Kansas district was transferred to the Levelland area, Levelland, Texas, as a petroleum engineer.

Elmer T. Ireton, petroleum engineer, was transferred from the Levelland area office to the Southeast district office at Shreveport, Louisiana.

▸ **Art Swanson,** formerly drilling superintendent for the Shell Group in New Guinea, has joined Socony-Vacuum Oil Company, Inc., and will leave shortly for Venezuela following a leave in the United States. He previously worked in Venezuela and Colombia.

▸ **L. S. Melzer** has been named assistant district geologist for Stanolind Oil and Gas Company's West Texas-Southeast New Mexico area, and will assist E. L. Reed, Permian basin district geological chief, at Midland, Texas. **Charles R. Barr** has been promoted from geologist in the Midland office to area geologist for the east side of the Permian basin.

▸ **Dean Wellman,** geologist for Shell Oil Company, Inc., at Oklahoma City, Oklahoma, for the past four years, has been transferred to the Denver, Colorado office, where company staff and operations are being increased.

▸ **Paul S. Johnston,** a man who has worked at everything from roustabouting, pumping, roughnecking, tool pushing, and drilling in the oil business to captain in the Army, has been named assistant professor of petroleum reservoir engineering at Texas Technological college.

Johnston, age 29, graduated from Oklahoma Military Academy High

Paul S. Johnston

school and Junior college, at which time he received a reserve officer's commission in the army. Interspersed with his schooling were several summers of work in the oil fields.

Following this, Johnston entered the military service, and upon his discharge was employed in Hobbs, New Mexico, as a tool pusher.

In January 1948, he received his BA degree in petroleum engineering at the University of Oklahoma and started work immediately toward his Master's in that field.

▸ **Harve H. Mayfield,** Magnolia Petroleum Company, was transferred to assistant superintendent of the West Texas producing division at Midland, Texas. Mayfield was formerly division petroleum engineer of that division. **Fred S. Wright, Jr.,** has been promoted to division petroleum engineer to replace Mayfield. He will be assisted by **James A. Graves.**

Gerald L. Smith has been transferred from the company's General Offices in Dallas to petroleum engineer in the Falfurrias producing district. **Robert W. Lewis** has been promoted to district petroleum engineer in Falfurrias. **Frank E. Long,** formerly of the producing department at Falfurrias, has been transferred to the petroleum engineering department at Salem, Illinois. **James G. Litherland, Jr.,** formerly petroleum engineer in the Louisiana-Gulf Division offices at Morgan City, Louisiana, has been transferred to Falfurrias.

Henry K. Holland, Jr., formerly district petroleum engineer at Electra, has been promoted to assistant division petroleum engineer of the Gulf Coast division with headquarters at Houston. **William H. Bowie,** formerly petroleum engineer of the Salem, Illinois district, has been promoted to district petroleum engineer at Electra.

Charles F. Girand has been made petroleum engineer in Magnolia's general offices in Dallas. He will be a member of the reserves and evaluation section of the petroleum engineering department.

John E. Shannon has been promoted to assistant superintendent of the natural gas department's Lake Charles and Louisiana-Gulf districts. His headquarters will be in Lake Charles, Louisiana. **Lee H. Robinson, Jr.,** will be promoted to assistant superintendent of the Seeligson natural gas district. His headquarters will be in Premont, Texas.

▸ **William A. Matthews,** geophysical supervisor, Rocky Mountain division Stanolind Oil and Gas Company, has been named division geophysical supervisor for the company's foreign exploration department, Canadian division, with headquarters in Calgary. He joined Stanolind in 1936.

▸ **A. T. Gibbon** has joined The Carter Oil Company's geological staff. He has been assigned to Mattoon, Illinois in the Eastern division.

McCullough

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of just where pipe is stuck, and

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Strikes Blows Both
UP and DOWN

Rotary Releasing
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Rotary
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Feeding
EXTERNAL
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31 SERVICE LOCATIONS

TEXAS: Alice, Houston, Cisco, Corpus Christi, McAllen, Odessa, San Angelo, Tyler, Victoria, Wichita Falls. **OKLAHOMA:** Oklahoma City, Guymon, Healdton. **MISSISSIPPI:** Laurel. **NEW MEXICO:** Hobbs. **KANSAS:** Great Bend. **CALIFORNIA:** Los Angeles, Avenal, Bakersfield, Ventura. **MONTANA:** Cut Bank. **LOUISIANA:** Houma, Lake Charles, New Iberia, Shreveport. **WYOMING:** Casper, Cody. **CANADA:** Edmonton. **VENEZUELA:** United Oilwell Service Co. **S.A.:** Caracas, Anaco, Maracaibo.

EXPORT OFFICE: 30 Rockefeller Plaza, New York 20, N. Y.

▸ **Walt Little,** drilling superintendent for Tropical Oil Company, in El Centro, Colombia, South America has retired from active service with the company and is returning to the United States.

▸ **Richard H. Marshall,** formerly production metallurgist of Timken Roller Bearing Company, has joined the metallurgical staff of the Climax Molybdenum Company at Chicago, Illinois. At Timken, Marshall initiated and conducted research on several high-carbon steels and later supervised the metallurgical inspection and heat treating of production steels.

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▸ **Russell C. Conkling,** consulting geologist in Midland, Texas, since 1935, has been appointed chief geologist for Plymouth Oil Company for the territory west of the Mississippi. He joined Plymouth August 15.

Conkling will work with W. M. Griffith of Sinton, Texas, vice president and general manager of Plymouth in Texas, Louisiana, Oklahoma, Kansas, New Mexico, and the Rocky Mountain region. His headquarters will be in Midland.

▸ **Victor H. Steele,** 64, Denver, Colorado oil man, died recently after a heart attack in Evanston, Wyoming. Former president and a member of the board of directors of U. S. Oil and Development Company. Steele worked for several years in Oklahoma and Texas oil fields.

▸ **J. R. Vandever** has been named general superintendent of the production department of Sunray Oil Corporation, according to an announcement made jointly by C. H. Wright, president, and H. O. Harder, Sunray's vice president for production.

Vandever has been assistant general superintendent of Sunray's producing activities since he was transferred to the company's Tulsa, Oklahoma, offices in March of 1948. Vandever, prior to assuming his supervisory duties at Tulsa, had been division superintendent of Sunray's North and West Texas division. He has been associated with Sunray since 1930, having a 19-year service record.

▸ **E. E. Rehn,** currently division geologist of the western division of Sohio Petroleum Company at Oklahoma City, Oklahoma, has resigned and is returning to Evansville, Indiana, to operate as an independent in the Tri-State area.

Prior to transferring to Oklahoma City, on April 1, 1949, Rehn had earlier served as eastern division geologist of Sohio at Evansville. He had been in charge of exploration work for Sohio in Illinois and Indiana for a total of seven years.

▸ **David W. Sellery,** former Los Angeles, California, division land man for The Ohio Oil Company, has been appointed division land man at Casper, Wyoming, the company has announced. He succeeds D. J. Griffin, who was recently appointed district manager at Calgary, Alberta.

Paul S. Geiger, formerly a member of the Los Angeles land department, has been promoted to the post of Los Angeles division land man.

Sellery joined Ohio in 1925 as a scout in New Mexico. After several years as a leaser in New Mexico and California, he was appointed Los Angeles division land man in 1941.

Geiger entered the land department as a draftsman in 1929 and became a land man in 1937.

▸ **Stefan Van Croy,** chief geophysicist for Barnsdall Oil Company, Tulsa, Oklahoma, was among a group of six geophysical and geological members from Barnsdall, Honolulu Oil Corp., who recently visited the Calgar, Alta., Canada, area. Others making the tour include: **H. C. McCarver,** chief geophysicist, Seaboard Oil Company, Dallas, Texas; **Virgil Feather,** seismologist, and **C. M. Cross,** Honolulu Oil Corp., San Francisco; **D. H. Thornburg,** and **W. V. Vandiver,** Seaboard, Los Angeles.

▸ **R. T. Short,** has been named geologist of the newly created Corpus Christi, Texas district of Continental Oil Company. Others assigned to the office are: **Robert J. Ross, M. B. Morris,** and **C .F. Greenwood,** geologists; **J. P. McGowan,** and **J. H. Cobb,** landmen; and **John W. McReynolds,** scout.

▸ **J. Marshall Nye,** assistant manager of production for Sohio Petroleum Company has resigned to join his father, Clark C. Nye, as an independent oil operator in Oklahoma City, Oklahoma. He will be replaced by **W. L. McCloy, Jr.,** former superintendent of operations for Sohio's eastern divisions with headquarters in Evansville, Indiana, J. M. Nye has been with Sohio for five years in production and engineering, and was formerly with Phillips Petroleum Company.

▸ **Claud Hildebrand,** 27 years in the land and scouting department for Phillips Petroleum Company, has resigned from the company. He will remain in Amarillo, Texas, where he will concentrate on operation of his own oil interests.

▸ **Ray Harris** has joined the geological staff of Lion Oil Company. He will be situated in the Midland, Texas, office. Harris formerly was at the firm's central headquarters at El Dorado, Arkansas. The Midland office is under the direction of F. H. McGuigan.

▸ **M. S. Mainland,** field manager of Iraq Petroleum Company, Ltd., and A. H. R. Grimsey, petroleum-research engineer for the company, are now visiting oil centers in the United States. Their headquarters are in Kirkuk in northern Iraq.

▸ **M. King Hubbert,** associate director for exploration at Shell Oil Company's Exploration and Production Research Laboratory in Houston, Texas, has been named a delegate to the United Nation's Scientific Conference on Conservation and Utilization of Resources.

Hubbert was chosen by Secretary of the Interior Julius Krug as one of the delegates from the United States to attend the international conference held at Lake Success, New York on August 17 through September 6.

A geologist and native Texan, Hubbert joined Shell in 1943, and was appointed to his present position two years later. He was graduated from the University of Chicago where he received B.S., M.S. and Ph.D. degrees. Prior to joining Shell he was a lecturer at Columbia University, worked with the U. S. Geological Survey and, during the war, as a member to the Board of Economic Warfare.

▸ **C. Edwin Mohler,** assistant chief geologist for National Associated Petroleum Company, Oklahoma, has been named chief geologist. Mohler has been with the firm four years, and formerly was with Carter Oil Company at Mattoon, Illinois.

▸ **Gerald A. Burton,** seismologist at Casper, Wyoming for Shell Oil Company, Inc.'s Rocky Mountain division, has been promoted to area geophysicist, and transferred to New Orleans, Louisiana. **Kurt F. Pilgrim,** administrative assistant at Los Angeles, California, has been promoted to exploitation engineer, Long Beach, for the Los Angeles Basin division.

▸ **Robert Womack, Jr.,** division development geologist, North Louisiana-Mississippi area, The California Company, Natchez, Mississippi, has been transferred to the development geology staff in New Orleans, Louisiana. He will be replaced in Natchez by L. C. Powell, geologist. Other changes include: **S. L. Kearly,** petroleum engineer, Lake St. John, Louisiana, transferred to the evaluations geology staff at New Orleans; and **J. R. Lynch,** petroleum engineer formerly with Richmond Exploration Company, named engineer at Rangely, Colorado.

▸ **W. Ed Leroux** has resigned as drilling superintendent for The Carter Oil Company to become production manager for C. L. McMahon, Inc., of Tulsa, Oklahoma. Sam Wells, geologist, has also joined McMahon as manager of exploration. He formerly was associated with Ashland Oil and Refining Company.

Attending the Houston Nomads meeting were: H. L. J. Hunter, Australasian Petroleum, Paupa, New Guinea; Marion Lowson, Anglo-Iranian, Iran; Roy L. Greenbar, Australasian; H. Sanchez, American Independent Oil, Houston; Ray Kail, Equipos y Servicios Especiales, S. A., Mexico City. Back row: Jimmie Doublas, Equipos y Servicios; E. W. Berlin, Standard Vacuum Oil, New York City, and A. E. Pedder, Anglo-Iranian.

Nomads Hear Iran Oil Discussed

Marion Lowson, of Anglo-Iranian Oil Company, Iran, described the drilling and producing problems of the Far East oil areas at the August meeting of the Houston, Texas Nomads Chapter. The visitor told 55 members and guests of the tremendous potential production of Iran, where the average well produces 20,000 bbl per day. Lowson was introduced to the Nomads by E. W. Berlin, Standard Vacuum Oil Company, New York City.

In addition to Lowson's talk, two other speakers addressed the group. Henry Mahaupt, Welex Jet Services, Fort Worth, Texas, presented a summary of the development of the jet principle from its inception in the "bazooka" for war-time use to its application in oil well perforating. Ray Dudley, of Gulf Publishing Company, on the future of the oil industry.

Guests present at the meeting were: Glenn Byers, Shell Oil, Houston; Ray Kail and Jimmie Douglas, Equipos y Servicios Especiales, S. A., Mexico City; Frank Baldwin, Oil Center Tool, and G. E. Burpee, Shell Oil, Houston; E. W. Berlin, Standard Vacuum, New York City; H. L. J. Hunter and Roy L. Greenham, Australasian Petroleum, Papua, New Guinea; Oscar A. Mellin, San Francisco; A. E. Pedder, Anglo-Iranian Oil, Iran; C. E. Puryear, Welex Jet Services, Inc., Houston; Henry Mahaupt, Welex, Fort Worth; Robert E. Bridges, Humble Oil; J. W. Elizardi, Hercules Supply Company; H. Sanchez, American Independent Oil Company, and J. R. Yancey, A-1 Bit and Tool Company of Houston; and Marion Lowson, Anglo-Iranian Oil Company, Iran.

▸ Personnel changes in Magnolia Petroleum Company's producing division include:

Kenneth R. Joynt has been promoted from assistant foreman to production foreman in the Magnolia Petroleum Company's Falfurrias, Texas district.

Garland C. Rutherford has been transferred from the petroleum engineering department at Falfurrias to the producing department there where he is assistant production foreman.

Harold Brewer, production foreman in the Freer area of Alice district, has been transferred to the company's Brownfield district as production foreman in the Scurry County area.

B. J. Sasser, production foreman at Salem, Illinois has been transferred to Luling, Texas as production foreman.

▸ **Mike Benedum,** wildcatter, has joined in the hunt for oil in Canada. On his 80th birthday, Benedum announced that he is joining Central Leduc Oils, Ltd., and Del Rio Oil Producers, Ltd., both of Calgary, to explore four crown reservations of 100,000 acres in southern Alberta, about 60 miles northeast of Calgary.

NEWS

Holds Annual Election

The Conservation Committee of California Oil Producers held the annual election of its two standing subcommittees in its meeting of July 27, 1949.

The new Administrative Committee consists of Bruce H. Robinson, General Petroleum Corporation, chairman; Chester F. Dolley, Atlantic Oil Company; H. G. Henderson, Severns Drilling Company, Ltd.; William L. Hobro, Shell Oil Company, Inc.; and Lloyd Williamson, Lakeport Petroleum Company.

The new engineering board consists of C. W. Stephens, Ohio Oil, chairman; E. A. Galvin, Western Gulf Oil; C. F. Gates, General Petroleum Corporation; Wayne Glenn, Continental Oil; O. A. Graybeal, Barnsdall Oil; Joseph Jensen, Tide Water Associated Oil; J. M. McNeill, Union Oil of California; M. T. Miller, Standard Oil of California; L. R. Rogers, Superior Oil; and E. R. Smith, Seaboard Oil of Delaware.

Changes Mexico Plans

Edwin W. Pauley is reported to be negotiating for two more drilling contracts with Petroleos Mexicanos to cover areas in Southern Tabasco State and in northeast Mexico.

Pauley also is understood to be disposing of part of his interest in the Mexican-American Independent Company which was formed earlier this year to carry out a 25-year drilling and production program in Tabasco and Veracruz States.

Partners with Pauley in Mexican-American are the American Independent Oil Company headed by Ralph K. Davies and the Signal Oil and Gas Company headed by Samuel B. Mosher, all of California.

Oil Reservoir Tank

The neatly built rack shown holding a discarded 52-gal drum, serves as the oil supply tank for three lease pumping engines. The unit, situated at one end of the lease, supplies the engines with crankcase oil. A regulator mounted on each engine governs the flow of oil to each motor and prevents burned out engines due to a low oil supply. This system also eliminates the need of many periodic oil inspections by the service crew.

The base holding the storage tank is fabricated by welding discarded sucker rod. A 5/8-in. water gauge glass mounted on the front of the barrel facilitates determining the amount of oil in the tank. (Photo at right.)

Forms New Company

Formation of Petroleum Technologists, Inc., production research, core analysis reservoir engineering, has been announced. The new company will have its headquarters in Montebello, California.

President of the organization is Dr. Norris Johnston, with N. Van Wingen, vice president.

Revise Wire Rope Standards

The National Bureau of Standards announces that a revision of Simplified Practice Recommendation R198-43, Wire Rope, has been proposed by a Standing Committee, for reference by the Bureau to all interests for comment, acceptance, or both.

The proposed revision, which adds a new table and effects a further reduction in variety of stock items, includes sizes, constructions, grades, and breaking strengths of the vast majority of tonnage of wire rope.

For the reason that as many wire-rope users as possible should have an opportunity to examine the proposed revision, the readers of this announcement are invited to make known their interest, by writing to the Commodity Standards Division, National Bureau of Standards, Washington 25, D. C. The names of all firms that are not already on the Bureau's mailing list of firms will be added immediately.

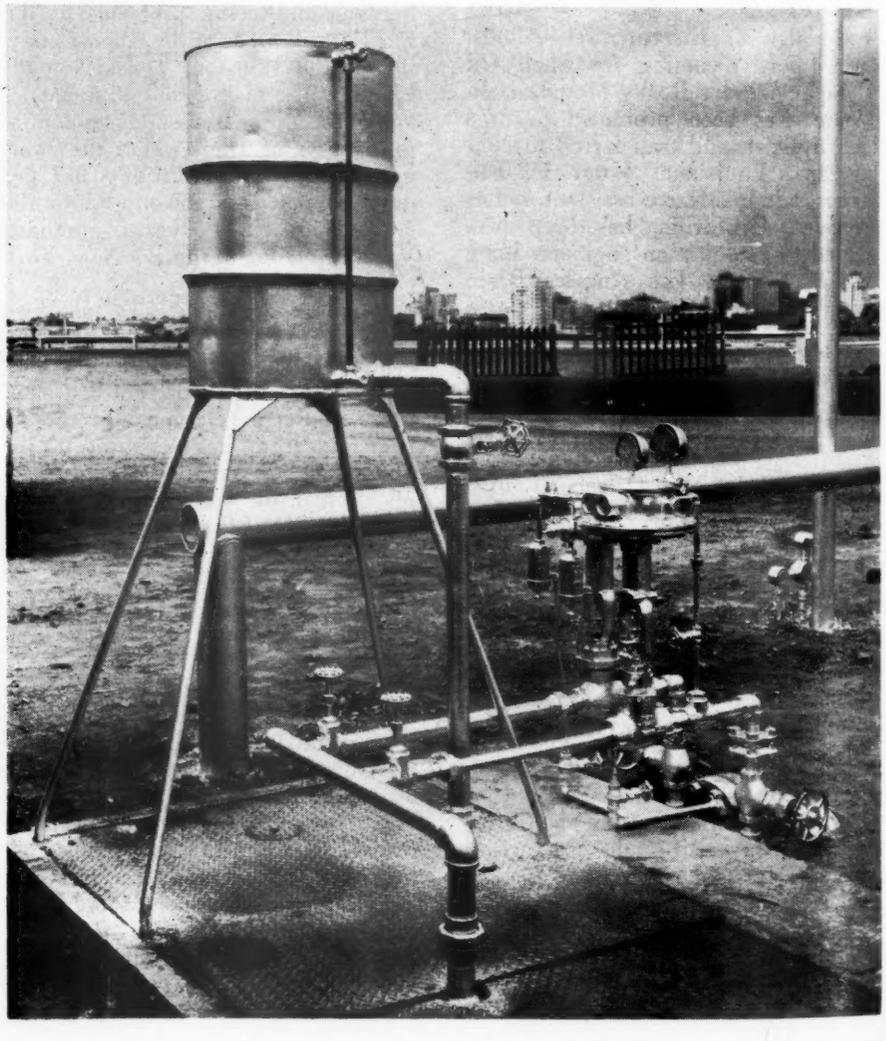
Pioneers Honor Past Presidents

At a meeting of the Board of Directors of the Petroleum Production Pioneers held last month in the new club rooms of the Petroleum Club, presentation of gavels was made to past presidents of the organization. First to receive was Henry Grinnell, vice president of the Key Contractors, Inc., PPPs' first president, one of its founders and one of the men who had the original idea that led to its formation.

Next to be honored was James Gosline, Standard Oil Company, now in San Francisco. Warren Johnson of the Standard organization and a PPP board member accepted in the absence of Gosline.

Lease oil supply tank.

Courtesy The Lincoln Electric Company.



OTIS "STORM CHOKES"

automatic protection against flow loss from damaged surface connections

The Type F Otis Removable Tubing Safety Valve Cage Assembly (shown in red) is available with three different lock-and-pack-off units for use according to specific well conditions: The Type J Removable Mandrel Assembly which seats and locks in a Type J Otis Landing Nipple and Flow Coupling; the new Type S Otis Removable Mandrel Assembly which allows the tool to be set at any one of several positions in the tubing string and allows the simultaneous use of Otis Removable Bottom Hole Regulators or Chokes in the same installation; and the Type B Removable Mandrel Assembly for wells in which the Types J and S Landing Nipples have not been installed. Each valve assembly can be made up with or without the Otis Equalizing Sub (Type B), and installed and removed under pressure on a steel measuring line with standard Otis running and pulling equipment.

Hurricanes and high water versus well connections. Falling barometers mean failing wells if a storm damages or breaks surface connections . . . if wild, uncontrolled flow wastes hundreds of barrels before repairs can be made. Protect your production by installing Otis Removable Tubing Safety Valves in the tubing string – *before* the storm season. Then you'll have an automatic, dependable *sub-surface* tubing flow shut-off if a break or leak occurs at the surface.

Otis Storm Chokes are pressure-differentially-operated type valves, pre-set to allow the flow to follow a single, straight course under normal production pressures. The instant any mal-function of surface connections occurs to the extent that the upward thrust of the pressure differential across the flow bean exceeds the valve spring compression, the tool automatically snaps to a positive shut-off. After surface connections have been repaired, the valve can be re-opened by equalizing pressures across it.

If your wells are in a storm area, or if they are producing near vital installations such as compressor stations, schools, highways, or other public property, you need the positive protection of Otis Safety Valves.

For literature on Otis Removable Tubing Safety Valves and other standard Otis tools and services, write Otis Pressure Control, Inc., Box 7206, Dallas, Texas, or contact the Otis field office nearest you.

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2000' AVERAGE PARAFFIN DEPTH

IN 62 LOUISIANA WELLS

at an average cost per well of only

*$480.**

Yes..we're talking price!

BECAUSE THE FACTS CAN PROVE IT

* One major oil company has the upper 2000 feet of tubing coated with "TK-2" Special-Kote in 62 oil wells located in Louisiana . . . at an average cost per well of only $480. Prior to coating, it was necessary to scrape the wells for the removal of paraffin every 3 to 7 days.

"TK-2" Special-Kote is equally successful in preventing paraffin adherence in flow lines, valves, and related equipment.

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Make Japanese Discovery

General Douglas MacArthur's headquarters have reported discovery of a new deep oil reservoir that is believed will probably double the present reserves of Japan.

Situated in Yabase, Honshu, the new deep zone was drilled during the month of July. Previously, the reserves of Japan had been placed at 14,000,000 bbl.

Sells Drilling Firm

The properties and the oil well drilling business of Jerry C. Hawkins, Dallas, Texas have been purchased by the newly organized Delta Gulf Drilling Company. Properties total about $15,000,000.

Announcement was made by Hawkins and by Joe Zeppa of Tyler, Texas, president of the Delta Drilling Company and president and treasurer of the Delta Gulf Drilling Company.

The interests include: Full or partial interest in 135 producing oil and gas wells and 22 oil well drilling rigs of heavy types, all other equipment used in connection with the operation of oil and gas properties, and the drilling equipment, producing royalties, wildcat leases and royalties and "all other assets with few exceptions."

IPAA Reports on Imports

Imports of crude oil and refined products averaged 607,000 bbl daily during the second quarter of 1949, the highest three months' daily average in history, according to a report by the Independent Petroleum Association of America.

The average for June, according to figures compiled by the IPAA from Department of Commerce statistics, was 632,000 bbl a day. Import volumes increased steadily during the three months ending June 30.

Other figures compiled by the IPAA show that the daily average second quarter imports from areas outside this country were: Venezuela, 270,000 bbl daily; Netherlands West Indies, 181,000 bbl; Middle East, 98,000; Columbia, 29,000; Mexico, 25,000, and all others 4,000.

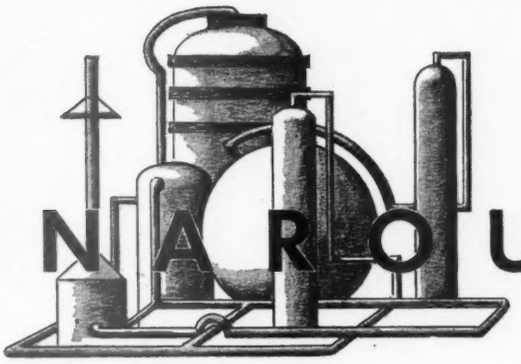
Student Wins Scholarship

A two-year scholarship financed by the East Texas Chapter of the American Petroleum Institute Production Division has been awarded to James Kelly Elliott, 19, of Overton, Texas.

Elliott, the first recipient of the scholarship program set up by the East Texas Chapter, was chosen for his outstanding record at Kilgore Junior College.

He will enroll in the petroleum engineering school of Texas A. and M. University this month.

THE TURNAROUND



Keeping the Refiner Abreast of Progress

Most significant among the numberless activities of petroleum refining management is that of making it possible to keep in touch with developments and advances being made continuously in pure or applied chemistry, engineering, and techniques in these fields.

The great majority of industrial scientists, chemists, and engineers leave school at the completion of their degree work, well informed as to the latest achievements, theories, etc., of research men, collegiate and industrial, in their particular fields. One of the identifying marks of the recent graduate is his discussion of more modern theories, his academic approach to industrial problems. This is all well and good; the vision of the "outsider" such as the new graduate is not yet clouded by the nearness of the worries and inhibitions of men long in industry.

As time passes the mental freshness of the, sometimes referred to as "callow", graduate wears off. Concentration on specific problems takes his mind away from the over-all picture of his science; he often follows the path of the definition of an expert, that of "knowing more and more about less and less." Pressure of the pace of modern applied research encourages and normally forces over-concentration and specialization.

Major refining company executives are recognizing this difficulty, in a very practical way, and are taking most effective steps to correct the situation. Elsewhere in this issue the large caliber efforts of one refining organization to enable its technologists of every type to keep up with new developments in theory and pure sciences is discussed in some detail.

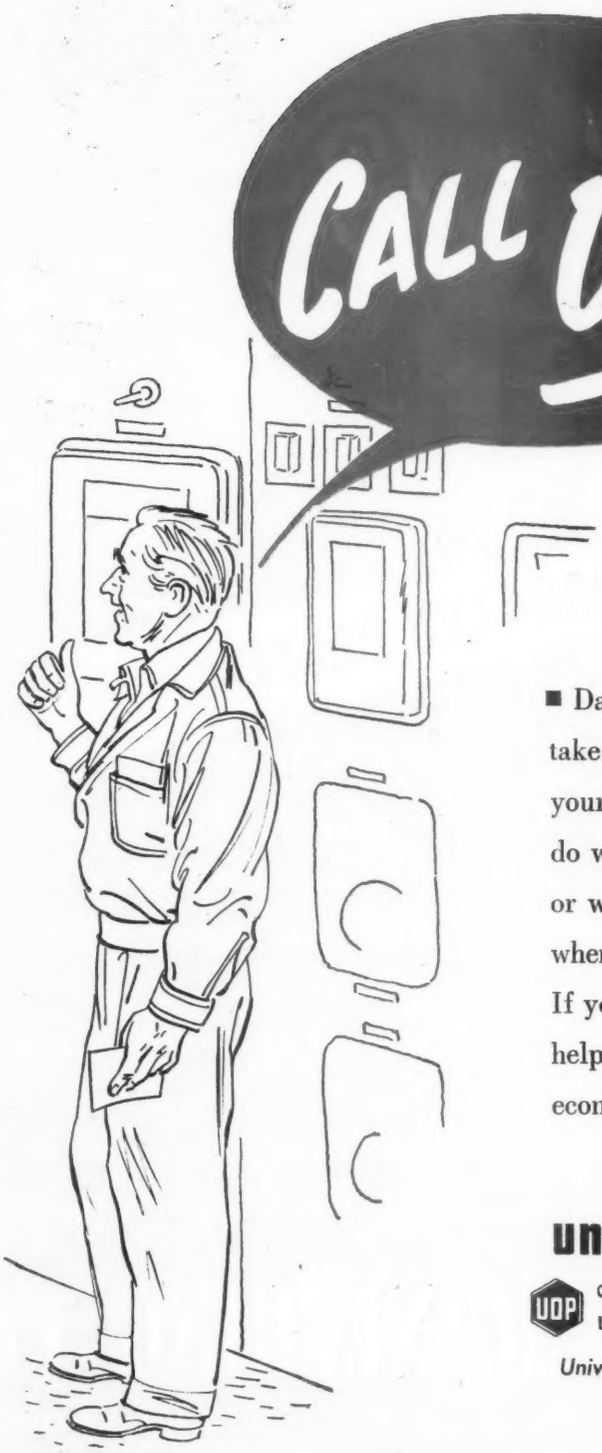
Attendance at these classes is arranged by the company; eligible men are chosen more or less in rotation, to present these advantages to as many of the technical staff as possible. In many cases the professors who give the lectures in their special fields are not acquainted specifically with the practical aspects of the industry to whose technologists they lecture. The purpose is to refresh the minds of the men on the fundamentals of the science.

Other companies are employing other means for this purpose. Some grant part or all of the expenses for night classes in college or other schools, or for correspondence courses taken and completed by the employe. They and others also take into direct account the work done in these courses in promoting men or in granting salary raises or preferred job assignments.

These activities give proof of the accelerated pace at which scientific, engineering, and technical developments are moving. No one is really *completing* his education, any more; he is merely passing successive milestones on his educational road. Obsolescence in either process, equipment, product, or staff minds is attained easily by resting on our oars. Such educational efforts as mentioned here must and will be increased.

—A.L.F.

...AND WHEN YOU NEED A HAND?



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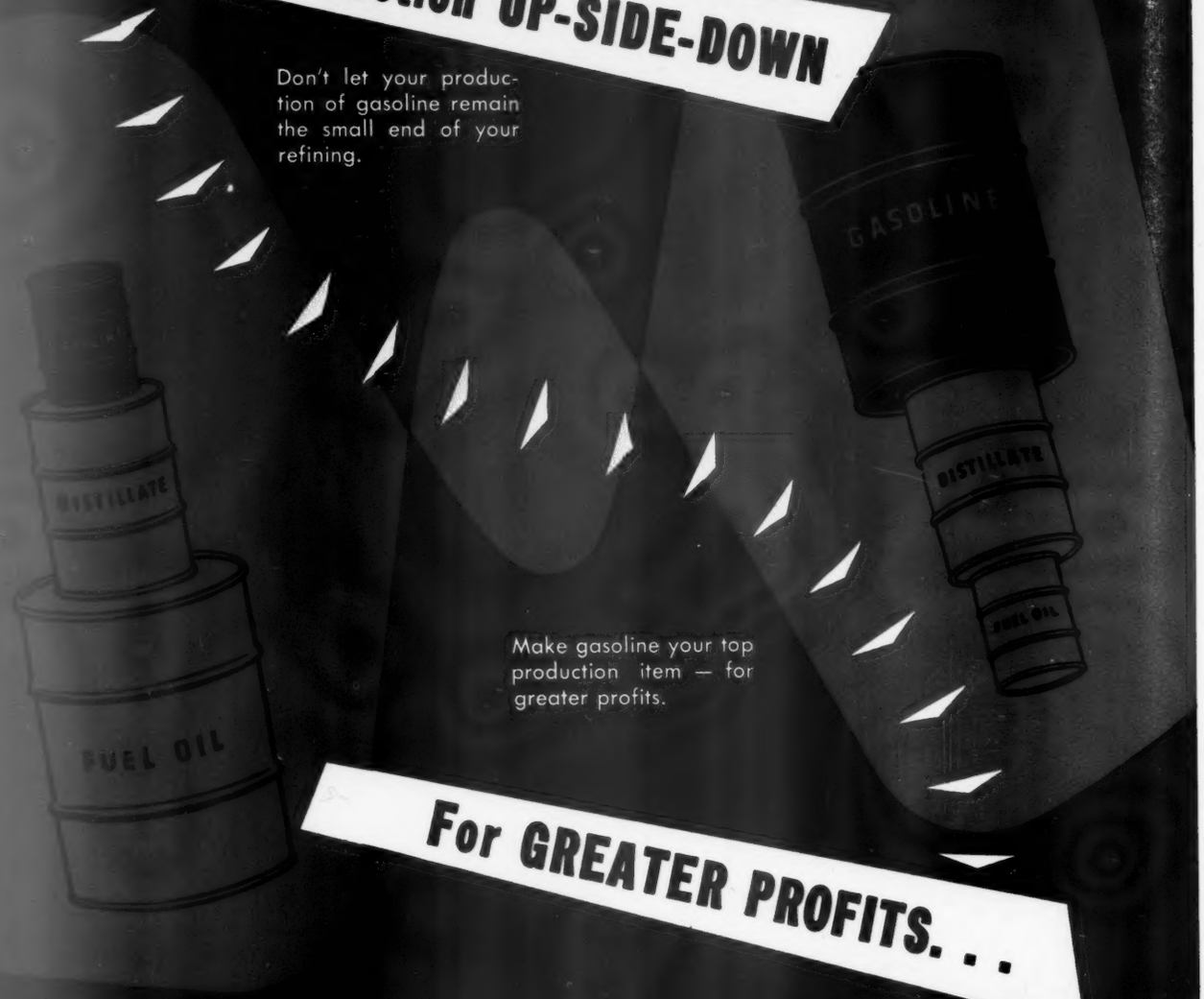

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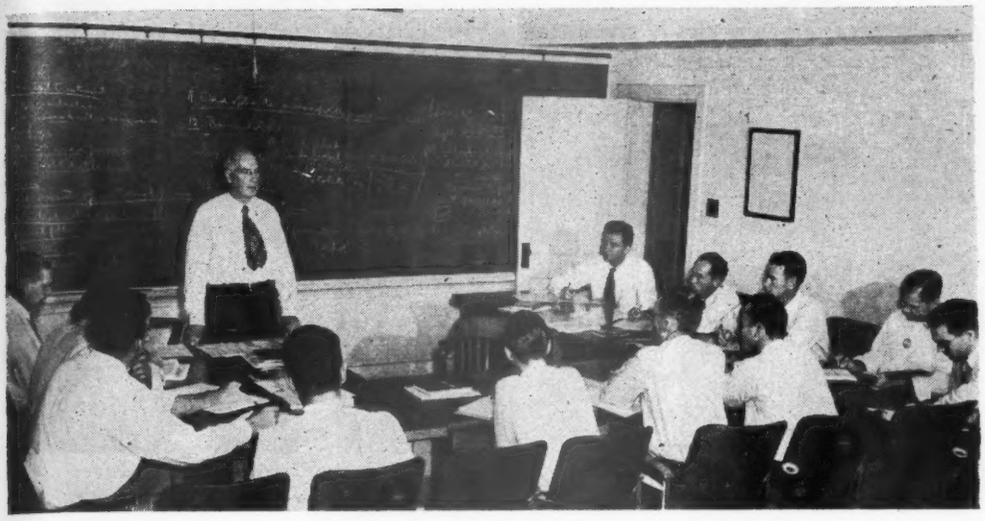


Dr. J. W. McBain, chemistry professor at Leland Stanford University, California, lecturing to a class studying Emulsions in Humble's science lectures program.

EXCLUSIVE

Science Lecture Courses Bring Technical Men Up-to-Date

ARCH L. FOSTER*

ONE of the greatest problems of technical men is to keep abreast of the new developments of science outside their own relatively narrow field after leaving college. The majority of technical men, chemists, chemical engineers, mechanical engineers, etc., enter one special field, such as petroleum chemistry, and soon they cease to be a specialist in their over-all field but concentrate only on one specific division of that field.

One solution of this problem has been for a company to encourage its technical men to attend night schools and other special classes available in local or nearby technical schools and colleges. But only a minority of the numerous industrial organizations are within reach of colleges so that only a small proportion of industrially employed technical men can take advantage of this opportunity. Other concerns have sent promising technical employes away for a given period to brush up in a special field, bearing part of or all the extra expense of such study. This method is fortunate for a very few, and Humble Oil and Refining officials could see only four or five men per year doing this sort of thing. At that rate some 30 years would be required to give every man this chance who warranted it, a totally unsatisfactory solution.

Consequently the plan was hit upon to bring to the main refinery at Baytown, Texas, a number of prominent educators, each a specialist in his field, to present courses in specific subjects. These lecture courses were open to all technical men who wished to attend and who enrolled for each course. Each man was released from other duties for the full time of the course in each case so as to allow him to devote his entire time to study and work at the course being presented.

To implement this system the Humble Lectures in Science program was worked out, to present different phases of chemical engineering, chemistry, and physics. By choice these courses were held strictly to the fundamental sciences; no vocation material was included by the lecturers, and therefore no refining technology was presented. The courses were given on company time; the attending employes were 'assigned' to the course attended as part of their duties for the company.

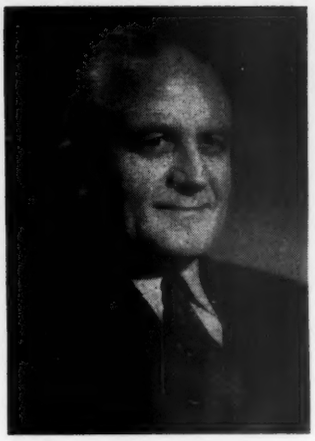
*Refining Editor.

Dr. H. D. Wilde, manager, Research and Development, Humble Oil and Refining Company, responsible for the lectures in science program of the company.

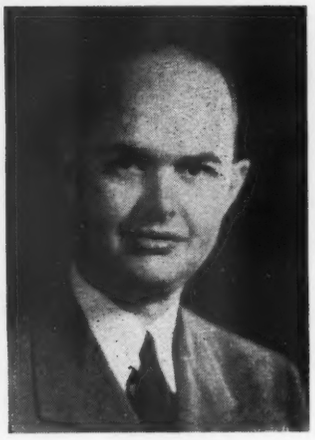
H. H. Meier, manager, Refining Technical and Research Divisions, also charged with broad administrative responsibility for the science lectures.

J. L. Franklin, research associate in Humble's technical staff, has the responsibility for the detailed arrangements for the science lectures program.

Allan P. Colburn



Barnett F. Dodge



Robert L. Pigford

Richard T. Arnold

Allan P. Colburn, research adviser, University of Delaware, is Ph.D. graduate of University of Wisconsin, 1929; was active during World War II with National Defense Research Committee and many other activities. He was on the research staff of duPont for 9 years until he went to Delaware in 1947, where previously he had been professor of chemical engineering for several years. He is a member of Phi Kappa Phi, Phi Lambda Upsilon, Tau Beta Pi, Sigma Xi; ASME, ACS, AAAS, AIChE, and the Newcomen Society, England. He has published many papers on distillation, heat transfer, etc., is chairman of Awards Committee, AIChE.

Barnett F. Dodge, professor and head, Department of Chemical Engineering, Yale University, took his undergraduate work at Massachusetts Institute of Technology, graduate work at Harvard, and received D.Sc. in 1925. Employed by duPont during World War I, he studied explosives including ammonium nitrate, and later lectured at Harvard, Worcester Polytechnic, and Yale. He has been head of his department since 1931. He has done research work on ammonia, methanol syntheses, metallurgical wastes, and catalysts. He is a member of Sigma Xi, Tau Beta Pi, AAAS, AIChE, ACS, etc.

Robert L. Pigford, professor and chairman of Department of Chemical Engineering, University of Delaware, did his undergraduate work in chemical engineering at Mississippi State College, obtaining his B.S. in 1938; M.S. at University of Illinois in 1941, and Ph.D. in 1942. He was a chemical engineer with duPont from 1941 to 1947, when he joined Delaware as professor and department head. He has published several papers on heat transfer and distillation subjects given before the American Institute of Chemical Engineers.

Richard T. Arnold received his Ph.D. degree from the University of Illinois in 1937, and joined the teaching staff of the University of Minnesota immediately as professor of organic chemistry. He has remained there ever since except for war work. During World War II he served for two and one-half years on the medical research committee of the Office of Scientific Research and Development. Arnold is chemical consultant to General Mills, and to the Smith, Kline and French Laboratories. He does research in stereochemistry and reaction mechanisms.

E. R. Gilliland, professor of chemical engineering, Massachusetts Institute of Technology, is a Sooner. He has a B.S. from Illinois U., M.S. from Penn State, D.Sc. from MIT, 1933, and more lately, the honorary D. Eng. from Northeastern U., 1948. At MIT he has climbed from instructor, 1934, to professor, 1944. Meantime he served as research director for Rubber Reserve, deputy chairman, National Defense Research Committee and Guided Missile Committee, etc. He is a member of ACS, Soc. Chem. Ind., AIChE, National and American Academies of Science. Received Bakeland Medal and Award for Achievement in Chemistry, 1944.

R. C. Fuson, professor of organic chemistry, University of Illinois, studied at Montana State University and University of California, receiving his Ph.D. from the University of Minnesota, 1924. He was National Research Council fellow at Harvard two years, later joining Illinois U., 1927. He taught at Ohio State, was visiting professor at Rice Institute, and was awarded honorary D.Sc. by Montana State, 1946. Spent a year on sabbatical leave, in Europe, 1935-36, visiting chemical laboratories. Is co-author of three textbooks on organic chemistry, and a member of ACS; has published 200 articles.

Paul D. Bartlett, professor of chemistry, Harvard University, did his undergraduate work at Amherst College, and received his Ph.D. from Harvard in 1931. He did various teaching and research jobs, returning to Harvard, 1934. His primary interests are stereochemistry and the mechanisms of organic reactions. He has worked out important steps in the mechanism of paraffin alkylation, and several other discoveries. During the recent war he did research on chemical warfare agents, insecticides and repellents. He is a member of Sigma Xi, ACS, National Academy of Sciences, and other organizations.

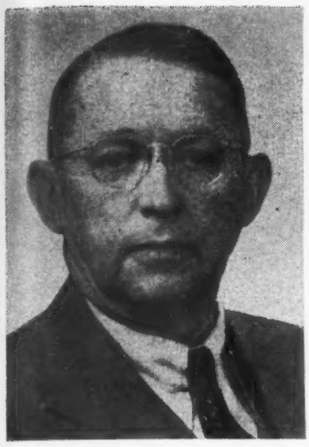
J. W. McBain, professor of chemistry, Stanford University, accepted recently the invitation of the Government of India to be the first Director of the National Chemical Laboratory, Poona, India. Born in Canada, he received his Ph.D. degree from Heidelberg University, Germany, in 1906, the

E. R. Gilliland

R. C. Fuson

Paul D. Bartlett

J. W. McBain



H. L. Lochte

Joel H. Hildebrand

Henry Eyring

Charles C. Price

honorary D.Sc. from Brown University in 1923, and the University of Bristol, England, 1928. He has taught in several American and British colleges and universities, and has been at Stanford since 1927. He is a member of a long list of scientific and honorary societies, and has published some 360 papers.

H. L. Lochte, professor of organic chemistry, University of Texas, studied organic chemistry under the late J. R. Bailey at University of Texas, and later under W. A. Noyes, University of Illinois. He received his B.A. at Texas in 1918, and his Ph.D. from Illinois in 1922. He joined University of Texas teaching staff in 1922 and has carried on research on catalytic reduction of nitrogen compounds, corrosion potentials, and analytical problems. His corrosion work has been in collaboration with the Natural Gasoline Association of America.

Joel H. Hildebrand, professor of chemistry, University of California, received his Ph.D. degree from University of Pennsylvania in 1906, studying later under Nernst at the University of Berlin. He was granted honorary D.Sc. by his Alma Mater in 1939. He became a colonel of chemical warfare in World War I, helping to direct research and development in that field. Hildebrand suggested use of helium-oxygen mixture which prevents 'bends' among divers. He is a member of Phi Beta Kappa, Sigma Xi, AAAS, honorary Fellow of Royal Society of Edinburgh, and has lectured widely.

Henry Eyring, professor of chemistry, University of Utah, was born in Mexico, and received his bachelor and master of Arts degrees from Arizona University, and Ph.D. from California, at Berkeley. He taught at the Universities of Wisconsin, California, Princeton, attending Kaiser Wilhelm Institute in Berlin, 1929-30. He became dean of graduate school and chemistry professor at Utah, 1946. Has been prominent in textile chemistry, did research on smokes and explosives during World War II, and has published several books and chapters of books. He is active in American Chemical Society, AAAS, Textile Research Institute.

Charles C. Price, professor and head of Department of Chemistry, University of Notre Dame, received his B.S. in chemistry from Swarthmore College, and Ph.D. from Harvard in 1936, under Louis F. Fieser. He spent 10 years at University of Illinois, rising from research assistant to Roger Adams, to associate professor. Joined Notre Dame as department head, 1946. He consults for Socony-Vacuum Oil Company, Eli Lilly Company, and the Chemical Warfare Corps. Prominent in research on polymerization, mechanism of organic reactions, and organic syntheses, he has published some 75 papers. He is active in ACS, AAAS, etc.

Frederick Albert Matsen received Ph.D. degree from Princeton University in 1940, specializing in quantum and statistical mechanics and in crystal structure. Associate professor in both the chemistry and physics departments of the University of Texas, he teaches courses in quantum mechanics, spectroscopy, statistical mechanics, and premedical physical chemistry. He is co-author with N. Hackerman and J. Myers of "Premedical Physical Chemistry."

H. A. Laitinen, professor of chemistry, University of Illinois, was educated at University of Minnesota, received Ph.D. degree in chemistry in 1940. He studied physiological chemistry, worked with Grasselli during summer vacations, joined Illinois faculty, and rose from instructor, 1940, to full professor, 1947. He was group leader of government rubber research project, 1943-46. His main research fields are electrometric methods of analysis, including polarography, potentiometric, and amperometric titrations. He is co-author of "pH and Electrotitrations" with I. M. Kolthoff, and has written 35 papers.

K. S. Pitzer, professor of chemistry, University of California, was selected as director of the U. S. Atomic Energy Commission's Division of Research, January 1, 1949. Graduated with B.S. degree from California Institute of Technology, Pitzer received Ph.D. from Berkeley institution in 1937, joining its faculty that year. He has served on leave to direct the researches of the Maryland Research Laboratory, 1943-44. American Chemical Society gave him the Award in Pure Chemistry, 1943, and the Army and Navy gave the A & N Certificate for his research work, 1948. He is active in American Chemical and other societies.

H. A. Laitinen

Frederick A. Matsen

K. S. Pitzer

Attendance was strictly voluntary and only those were enrolled who had shown interest in the work.

These courses were planned, not as review of science studied earlier, but "to advance the level of technical training"; men were selected on this basis, and each man was expected to stand examination in the course at the end of each series of lectures. Six separate courses were offered each year, and it was arranged that each technical man should have opportunity to attend a course at least once in three years. During the first two years, practically every technical man on the staff who was interested has had at least one course and a number have had more than one course.

A certain number of courses were given that include material of about the level of the first graduate year in college to take care of men who have only bachelor's degrees. The majority of courses have been at a level in advance of this first graduate year. At first, in presenting courses for which qualified instructors could be engaged locally, it was decided that one lecture per week would be desirable, instead of presenting the whole course intensively in two to four weeks, and to extend these courses over periods up to nine months. Experience showed that this plan worked a definite hardship on both lecturers and students. Whenever possible courses hereafter will be presented over a period of one to four weeks, the average requiring about two weeks, working full time each workday.

Outline of the different courses is given in the accompanying table, including several yet to be presented during the current year. Quoting from the report by J. L. Franklin:

> "To date we have given courses on High Polymers, Mechanisms of Organic Reactions, General Organic, Hydrocarbon Chemistry, Spectroscopy and Statistical Thermodynamics, Thermodynamics of Solutions, General Physical Chemistry, Azeotropic and Extractive Distillation, Mathematics of Chemistry and Chemical Engineering, Transference of Processes from small to Large Scale, Physical Problems of Analytical Chemistry, and Emulsions. We have in prospect for the next few months courses in Reaction Kinetics, Chemical Engineering Thermodynamics, and Theoretical Organic Chemistry. We have been fortunate in obtaining the services of some of the country's most able and respected scientists to present courses, among them Professors Hildebrand and Pitzer from University of California, McBain of Stanford, Fuson and Laitinen of Illinois, Arnold of Minnesota, Gilliland of M.I.T., Dodge of Yale, Colburn and Pigford of Delaware, Bartlett of Harvard, Price of Notre Dame, Eyring of Utah, and Matsen and Lochte of Texas."

In making plans for these courses a number of subjects are suggested to the technical personnel of the company and they are asked to indicate the courses they would like to attend, provided adequate arrangements can be made. On the basis of the returns from this poll six courses are selected to be given during the next "academic" year and plans go forward to obtain desirable lecturers to present each. Instructors are asked if they have no prior commitments to agree to hold in confidence any confidential information discussed regarding the company's refining practices or research developments; with this arrangement, discussion between instructor and students is free and untrammeled, permitting free interchange of ideas during the course. However, in a few instances the instructor has had a consulting agreement with another company which prevented such an arrangement.

Only the broad field of the subject to be presented is specified to the instructor, who is given the widest latitude and freedom in the selection of the material to be given in the courses. Selection of class members is made by the supervisors from among the technical men who signify a wish to attend the specified course. In deciding who shall attend what course, such factors as the pertinence of the subject to the individual man's work and duties, if each can be spared for current duties, and if each is prepared adequately to study the course considered, are weighed carefully. Small classes are considered imperative, and the upper limit of numbers has been set at 16 with 14 about the average group.

Students devote their entire work time to the course. Some instructors spend more time lecturing than do others; those devoting less time to classroom lectures assign readings, problems to solve, etc., to occupy the time of the members. Instructors have lectured from 2-3 hours per day to a maximum of 7 hours. Facilities for transportation, lodging, etc., for instructors are arranged by the company or they are aided in making these arrangements. A car is set aside for the use of the instructor during the period of his work and entertainment of various sorts is arranged for them.

The program has been in operation three years, and is being received with increasing enthusiasm by the company's technical men. Obviously the courses cannot be expected to produce immediate and specific results. The company feels that the main purpose of the program is the general and gradual upgrading of the technical level of the employes, improvement of their general proficiency, rather than specific results directly traceable to the courses. The program will continue as long as it is received with a degree of enthusiasm and is as successful as it has proved to be in the past, officials state. ★ ★ ★

COURSES GIVEN IN "HUMBLE LECTURES IN SCIENCE"

Professor	Course	Dates
F. A. Matsen	Physical Chemistry	Aug. 1, 1946-March. 31, 1947
C. C. Price	High Polymer Chemistry	May 29-June 6, 1947
H. L. Lochte	Organic Chemistry	Aug. 19-23, 1946
E. R. Gilliland	Transference of Processes from Small to Large Scale	Sept. 24, 1946-July 1, 1947
R. C. Fuson	Advanced Hydrocarbon Chemistry	Nov. 4-12, 1946
K. S. Pitzer	Spectroscopy and Statistical Thermodynamics	Jan. 13-24, 1947
E. R. Gilliland	Transference of Processes from Small to Large Scale	Feb. 3-14, 1947
H. A. Laitinen	Physical Chemical Problems of Analytical Chemistry	Aug. 18-29, 1947
A. P. Colburn	Advanced Topics in Distillation	Sept. 2-10, 1947
R. T. Arnold	Advanced Topics in Organic Chemistry	Sept. 22-Oct. 1, 1947
J. H. Hildebrand	Thermodynamics of Nonelectrolytic Solutions	Feb. 2-13, 1948
R. L. Pigford	Mathematics of Chemistry and Chemical Engineering	March 15-26, 1948
F. A. Matsen	Physical Chemistry	June 14-25, 1948
J. W. McBain	Emulsions	July 19-30, 1948
		May 24-June 4, 1948
		Aug. 23-Sept. 3, 1948
		Nov. 1-12, 1948

COURSES TO BE GIVEN IN 1949 AND 1950

Professor	Course	Professor	Course
B. F. Dodge	Chemical Engineering Thermodynamics	Henry Eyring	Kinetics and Catalysis
P. D. Bartlett	Theories of Organic Reactions	F. A. Matsen	Physical Chemistry
Saul Winstein	Mechanism of Organic Reactions	Hugh S. Taylor	Adsorption and Surface Phenomena
A. D. Walsh	Oxidation of Organic Compounds	R. L. Pigford	Mathematics of Chemistry and Chemical Engineering
O. A. Hougen	Applied Kinetics		

HEAR FOREIGN LECTURER

Dr. A. D. Walsh, University of Leeds, England, is the first professor outside of the United States to give a series of lectures to the Humble Oil and Refining Company's employees. Dr. Walsh, who arrived from England in August, will give a course on oxidation of organic compounds.

The first of the series, begun in July, was a course on the mechanism of organic reactions given by Dr. Saul Winstein, University of California at Los Angeles. The other lecturers in the series are Dr. O. A. Hougen, University of Wisconsin, who in December will lecture on applied kinetics; Dr. Hugh S. Taylor, Princeton University, who speaks in January or early February, 1950, on adsorption and surface phenomena; and, Dr. R. L. Pigford, University of Delaware, who will lecture on mathematics of chemistry and chemical engineering next April.

Paluxy Asphalt Company plant at Crupp, near Yazoo City, uses crude oil from Tinsley field, Mississippi

P 710.1

Southland Plants Are Mississippi's Own

A. A. SPENCER*

THE name Southland is synonymous with oil refining in Mississippi, for of the two operating refineries in the state, both are under the Southland banner.

The original of these two plants is the Paluxy Asphalt Company refinery at Crupp, Mississippi, six miles south on Highway No. 3 from Yazoo City and served by the Illinois Central Railroad. Construction on this plant was started in the middle of January, 1941, the plant being completed and put on stream July 1 of that year.

This plant was originally designed as a 2500-bbl capacity plant to process Tinsley crude oil and was a combination skimming and thermal cracking plant. Construction was continued and the asphalt plant was placed in operation in the last quarter of 1941, which included a battery of oxidizing stills providing flexibility in asphalt production. Since the original construction of the plant, there have been many additions to both the skimming and thermal cracking capacity with three additional heaters being added, the last have been completed and placed in operation this year, which gives the plant a total throughput capacity of 4000 bbl of crude oil per day.

The first of this year, construction was started on a light ends recovery

*President, Southland Oils, Inc. See Refining Personality, Page C-51.

EXCLUSIVE

system and catalytic polymerization unit, which will have a capacity of 270 bbl of polymer gasoline per day. The construction is practically complete and this unit should be in operation around September 1. This will add materially to increased production of high octane gasoline as well as supply butane and propane, to be sold in the local markets.

Also under construction at the present time are new oxidizing stills, which will modernize the operations and increase oxidizing capacity of the plant.

The second plant operated by Southland is located at Sandersville, Mississippi, approximately 12 miles northeast of Laurel on Federal Highway No. 11 and is served by the Southern Railroad.

This plant was originally built by Rogers Lacy of Longview, Texas in the early part of 1946 and started operation in the early summer of that year. It was designed to process Heidelberg crude oil. Its original capacity was 1500 bbl per day and was a combination skimming and asphalt operation.

In January, 1947, this plant was acquired by the Southland Oils, Inc. Extensive alterations were made with installation of vacuum tower and a complete new steam generating plant and was placed back in operation in May of that year. This plant has been enlarged and has a rated capacity of 5000 bbl per day running Heidelberg crude oil.

Both plants are served by their own pipe lines and each has field gathering systems, together with connections to other gathering systems operating in each field.

The Paluxy Asphalt Company plant at Crupp was designed for operation on Tinsley crude oil, producing a complete line of products from ethyl gasoline to all grades of oxidized and paving asphalts.

Tinsley crude is a fairly light gravity crude oil, the field average ranging from 33 to 34 API, and is an asphalt base oil; however, the asphaltic content of 50 penetration is approximately 15 per cent. Asphalts from Tinsley crude, however, will meet practically all normal state specifications, but specific gravities are on the light side.

Although the sulphur specification on Tinsley is 0.79, all light products contain very low sulphur percentage and straight run gasolines and kerosines made from this crude will stand doctor without even a caustic wash. The caustic wash is employed, however, to make certain of good odor.

Staight-run gasolines with an end point of 300 have a clear octane of 52 and as generally true with all gasolines made from Mississippi crude, has a very high lead response, for with 3 cc's of lead it has an octane of 79.5 motor method.

Thermally cracked gasolines from Tinsley crude oil show exceptionally high research octane numbers. Material with 350 end point will show a clear octane of 69.8 motor, leaded with 3 cc's, 77.6 motor and 88.3 research.

Kerosines cut from Tinsley crude oil are exceptionally high quality and as is the general characteristic of light oils from this type crude oil, have a high API gravity. Total sulphur is

Sandersville plant near Heidelberg field, Mississippi, one of two refineries in the state.

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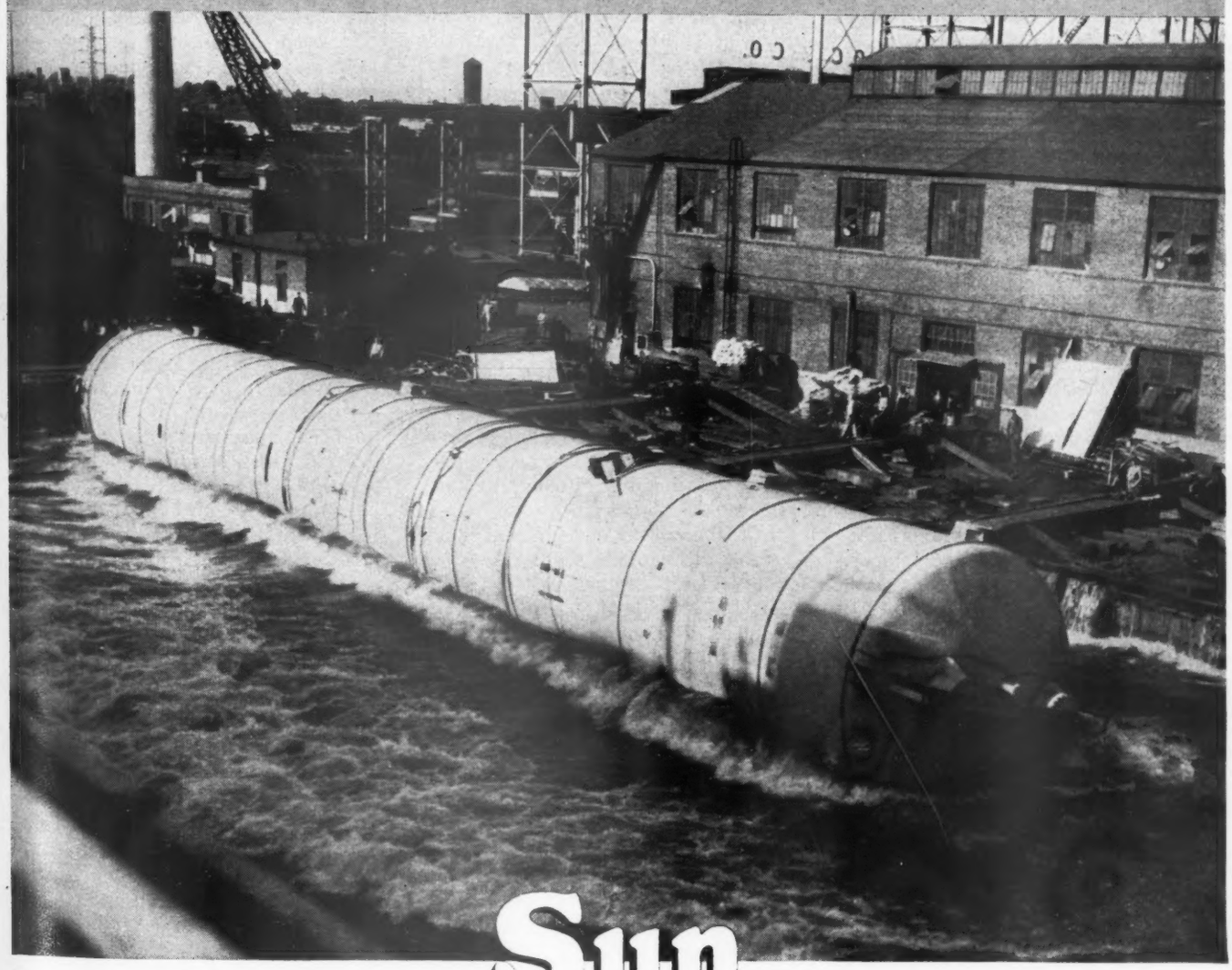
Besides having the know-how and facilities for fabricating every kind of refinery and chemical plant equipment, Sun is ideally located. Sun-built units such as this tower, too large to be shipped by rail, can be transported by water—floated or carried as deck loads or on barges . . . Here, too, on the deep Delaware River, Sun builds its famous tankers and cargo vessels.



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0.06 per cent or less and will show a 25 plus color Saybolt.

Diesel fuel, as with kerosine, shows very low sulphur and has cetane numbers from 55 to 57.

Residual fuels made from Tinsley crude are objectionable, however, in the fact that they contain more than 1 per cent sulphur.

Heidelberg crude oil, which is processed at the Southland Oils, Inc., plant in Sandersville, is quite different from Tinsley in that it is of lower gravity, the field average being around 23. This oil is a high asphalt content crude containing 49 per cent of 85 penetration asphalt with higher specific gravities than Tinsley. Asphalts produced from Heidelberg crude oils are comparable to the products produced from heavy Mexican crudes and will meet all specifications, including the City of Chicago.

Heidelberg as compared to Tinsley contains much higher sulphur as it runs as high as 4 per cent or slightly more. Straight-run gasolines from this crude are not excessively high in sulphur, however, but on the whole are approximately 0.02 per cent more than straight-run gasolines from Tinsley crude. The clear octanes of these straight-run gasolines are comparable to Tinsley with a 320 end point cut, showing 48 motor octane and with 3 cc's of lead, the octane is raised to between 75 and 76.

Kerosines from Heidelberg crude have a slightly higher percentage of sulphur than Kinsley, but meet state specifications, being less than one-fourth of 1 per cent. Finished kerosine will run 20 plus Saybolt. Gasolines and kerosines from Heidelberg, unlike Tinsley, require caustic wash to meet doctor test.

Diesel fuels made from Heidelberg crude are fairly high in sulphur; but the diesel fuel produced at the Sandersville plant is less than .75 percentage of sulphur.

All products produced by the Paluxy Asphalt Company plant at Crupp and the Southland Oils, Inc. plant at Sandersville are marketed by the Southland Company. All light oils are sold under the company's trade brand and a large volume moves through controlled outlets.

In the years that Southland has been operating in Mississippi, there has been established franchise dealer setups throughout the state and the company operates through a number of its own bulk plants.

A sizeable part of the delivery within the state, as well as into Alabama and Tennessee, is made with the company's own truck fleet.

Domestic asphalt sales are confined principally to the states of Mississippi, Tennessee, Alabama, Georgia, Florida, and Kentucky. Southland was instrumental in establishing truck delivery within 150 mile radius of refineries in specially designed asphalt hauling equipment.

The proximity of both plants to the Gulf has made it possible for a sizeable volume of export business on asphalt. During the war, the company enjoyed a considerable movement of asphalt for export to South America, as well as supplying a considerable volume of material on lend-lease. Export sales have continued and there has been a continuing movement, especially to the European area, as well as Southern Asia, Africa, and South America.

* * *

Shell Chemical Plant Aids British Supply

The new Shell chemical solvents plant, opened at Stanlow, Cheshire, on July 20, is the first of its kind in Europe, and of vital importance, technically and economically, to the future of British industry. From this plant Shell will produce annually some 24,000 tons of chemical solvents. Here Shell will crack oil into chemicals suitable for the paint, varnish, perfumery, textile, drug, leather, plastic, film, printing ink, and allied industries. All sorts of insecticides, fungicides, and soil fumigants will be made available.

Much of this material was imported previously and the development of this new plant will make the sterling area less dependent on the U.S.A. A still more important development is the fact that the introduction of petroleum-chemical engineering on such a scale must lead to related expansion in many fields of chemical engineering. It is therefore highly probable that apart from the immediate saving of dollar expenditure the establishment of this plant will give a lead to the development of new chemical industries.

The petroleum used at Stanlow will be drawn from the Middle East, and will involve no dollar expenditure. Export of part of the production will lead to competition in the export market and to some earning of revenue.

The actual saving in reduced import of solvents from the U.S.A. is estimated at some $5,000,000, at present prices. No effort has been made, as yet, to estimate the potential export value of the plant.

In favour of the development is the fact that the plant has been so designed as to permit production of almost every known type of chemical solvent. The plant is the most up-to-date in the world and has been built to the extent of 97 per cent with British equipment.

Other chemicals-from-oil plants are currently being established in Great Britain, although none are so large as this first unit. Between them these new plants will provide Great Britain with a chemicals-based-on-oil industry, a need which has long been admitted.

One important feature of the development is the fact that even within Britain itself several traditional industries will now have to face much more acute competition. The rise of synthetic detergents in the past few years has created such a situation for soap makers, and there is every prospect that an expanding flow of such detergents can be expected from these new plants.

ASTM Symposia

On October 10-14 the American Society for Testing Materials will hold two symposia of wide interest to the petroleum industry, it has been announced. These are on High Additive Content Oils, and Turbine Oils. In addition several technical committee meetings will be held during this meeting, including those by Committee D-2 committees, and others by Committee D-4 on Road and Paving Materials; D-8 on Bituminous Waterproofing and Roofing Materials, and D-18 on Soils for Engineering Purposes.

The symposium on High Additive Content Oils will include papers by W. B. Bassett, Lubrizol Corporation; A. B. Boehm, Enjay Company and C. O. Tongberg, Standard Oil Development Company; N. L. Klein, Office of Chief of Ordnance, Department of the Army. The symposium on Turbine Oils will listen to discussions by V. Estcourt, Pacific Gas and Electric Company, San Francisco; T. N. Bath, Shell Oil Company; F. S. Jones, Socony-Vacuum Oil Company, Inc.; and F. C. Linn, General Electric Company, on lubrication of gas turbine equipment. Other programs of interest to the industry will be presented during the five-day session.

The Ethyl Technical Man brings the refiner

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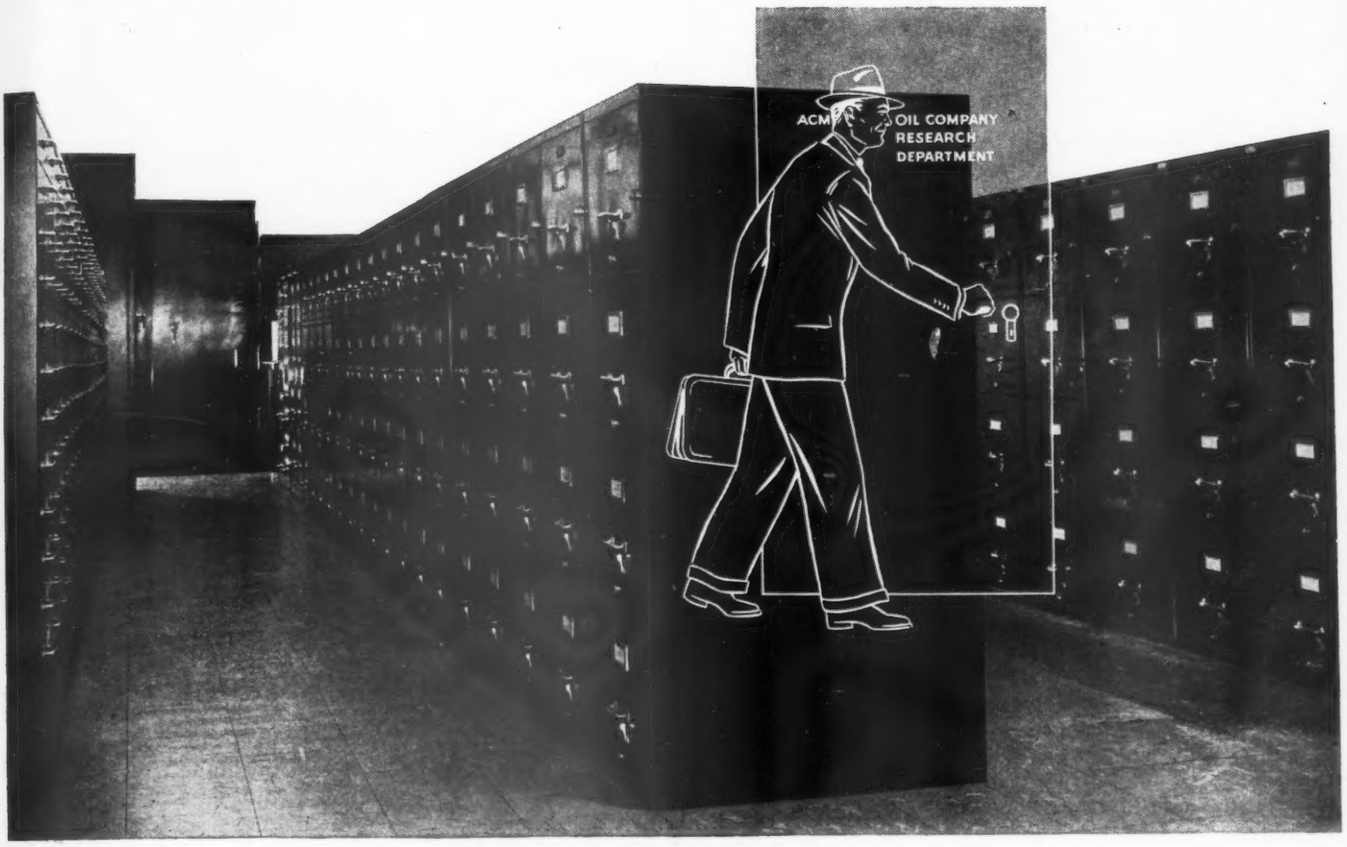

Twenty-six years of extensive fuel-engine research work at Ethyl have built up vast files of basic information on fuels and engines. These are being continuously expanded by the addition of results from current programs. Making this material useful to oil companies is the full-time work of a staff of Ethyl Technical Representatives.

The dual function of this group is:

1. **To interpret Ethyl's accumulated technical information in the light of each refiner's specific problems, as an aid to the economical production of satisfactory fuels for today's and tomorrow's automobile engines.**
2. **To keep the Ethyl Laboratories informed on the problems and technical interests of the oil companies as a guide to the formulation of Ethyl's research objectives and programs.**

The technical information in the files of the Laboratories covers a wide range of subjects related to the problems of refining gasoline. More important, however, than the knowledge accumulated on individual subjects is the understanding acquired of the many complicated interrelationships of engines, fuels, and lubricants.

Ethyl Technical Representatives have all had long experience in the Research Laboratories and have helped to develop the information which they now make available to refiners. All the extensive technical data kept in the Ethyl research files and all the results of current research programs are available to these technical representatives.

Because they are so thoroughly informed on Ethyl's research activities, they are of maximum help to refiners on problems related to the utilization of gasoline in engines. If a refiner's particular problem makes desirable a discussion between his specialists and Ethyl Research specialists in the same field, the Technical Representative is usually able to arrange such a meeting.

The wide experience of Ethyl Technical Representatives and their familiarity with Ethyl's research programs contribute to one of Ethyl's most important research objectives—

developing and distributing information to assist refiners in economically producing satisfactory gasoline.

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Part 4

Life and Death in an Oil Refinery

P. M. VAN ARSDELL

Hydroforming

THE *hydroforming* process converts the naphtha cut of hydrocarbons to aromatics and naphthenes, and olefins to cyclic and aromatic compounds.[38] The temperatures of the reaction range from 900 F to 1100 F and pressures from 150 to 300 psi. The process uses an alumina-molybdena catalyst in the presence of a hydrogen-rich gas. The hazards of operation are comparable to those given for thermal and catalytic cracking. The molybdenum ion in the catalyst is characterized by weak toxicity and great rapidity of elimination from the body should it be inhaled or swallowed.[33] The major source of danger from this process is absorbing through the lungs or skin the final products, which are benzene, toluene, xylenes, and cumene.[32]

Initially the inhalation of benzene and its homologs closely resembles that of the other hydrocarbon groups, producing muscular tremors, salivation, exhaustion, paralysis, rapid respiration, at first, then slow; then a rapid pulse, lowering of the temperature, and in fatal cases, narcosis, delirium, convulsions, and death from paralysis of the respiratory center.[83] Acutely, benzene acts as a nerve poison causing faintness, headache, excitation, pallor, and later flushing, weakness, tightness of the chest, visual disturbance, and bluish coloration of the skin (cyanosis). Benzene is absorbed by the skin leading to the same symptoms as inhalation only slower in onset.[86, 107, 112]

The reaction of the eyes to the vapors is initially conjunctivitis, then inflammation of the eyelids, and sometimes inflammation of the cornea. After the inhalation, the eyes may show retinal hemorrhages and inflammation of the optic nerve.[49]

Benzene acts as a cumulative poison and while the acute phases are mainly those of a nerve poison, its chronic effect is that of a blood poison. Chronic benzene poisoning is far more dangerous than the acute form. The blood picture shows—

(1) Formation of fat emboli in the capillaries that first blocks them and then causes them to burst showing red areas over parts of the skin, that is, hemorrhages under the skin.[126]
(2) Scarcity of white blood cells caused by the failure of the bone marrow to continue their manufacture.[136]
(3) Anemia, the red cell count may drop to as low as 1,070,000[82] as against the normal 4.5 to 5.0 million.[136]

Susceptibility to blood reactions varies considerably with individuals, the younger the person usually the more pronounced are the symptoms.[83]

First aid consists of removing the overcome person from benzene fumes to fresh air immediately and calling the doctor. When benzene contacts the skin, it should be washed off immediately with plenty of soap and water — no time should be allowed for its possible absorption. Respirators and gloves, rubber aprons, and boots should be worn whenever there is danger from splashing.

The following Table 8 shows the effects of exposure to benzene in various concentrations.[86]

TABLE 8.

Concentration in air	Effect
100 ppm	Objectionable
4695 ppm (15 mg/liter)	Listlessness and confusion in ½ hr.
6260–9390 ppm (20-30 mg/liter)	Loss of consciousness; dangerous to life in ½ to 1 hr.

As a precautionary measure, frequent blood counts and urinalyses should be made on those workers constantly operating this process.

Toluene on inhalation produces initially headache, nausea, drunkenness, vomiting, loss of consciousness, disturbances of the equilibrium, and numbness. Recovery is fairly rapid on removal from exposure.[46] The chronic symptoms are headache, dizziness, loss of sleep, and intolerance to alcohol. There is considerable irritability and incapacity to work.[46] The blood picture is seldom as severe or devastating as in benzene poisoning, although in certain instances blood changes have been noted, especially when concentrations of over 500 ppm are contacted for some time.[154] First aid and protective measures are the same as for benzene.

Xylene has much the same effect on initial inhalation as benzene and toluene; there is giddiness and intoxication, and perhaps loss of consciousness. Later symptoms include fatigue, dizziness, palpitation, burning in the head, drunkenness, numbness of the hands and feet, shivering, and anxiety. Recovery from acute poisoning may be followed by excitement, gastric pain, headache, loss of sleep, and nervousness. Chronic xylene poisoning is similar to that from toluene, with important additional symptoms being heart and circulation impairment and kidney injuries. Xylene produces a characteristic feeling of heat, reddening of the face, and dryness of the throat, believed to be due to the dilation of the blood vessels. No blood changes have been reported.[46]

Pure cumene and the industrial product have a potent narcotic action characterized by slow onset, and long duration once the symptoms are established. The comparatively low volatility of cumene should result in easier control of toxic concentrations in the air. However, there is danger of cumulative action from low concentrations as the compound is but slowly eliminated from the body. In animal experiments, cumene has been shown to affect adversely the liver, kidneys, and spleen. The reaction indicates some fatty degeneration of the liver and kidneys and the blood picture was found to be altered on examination of the spleen.[150]

Since the hydroforming operation produces these aromatics in a mixture, any untoward reaction may be due to the effects of all the compounds and not to any one specific compound. Frequent blood and urinalyses should be the rule, and whenever persons are required to work in atmospheres where aromatics are likely to be present, airline respirators, rubber or neoprene gloves, aprons, and other body protection must be used. Proper cleaning of the rubber apparel is also necessary to prevent the solvent action of aromatics on rubber and to

EXCLUSIVE

—*Courtesy American Optical Company.*

Split leg apron of chrome-tanned cowhide leather. Frontal protection from neck to just above knee.

maintain their efficiency. Proper personal hygiene must be enforced and any untoward physiological reactions reported at once to the medical department.

The toxic properties of benzene, toluene, and xylenes have been recognized for many years, but the higher homologs such as cumene, ethyl-benzene, and styrene are fairly recent industrial products. Until adequate research and data have been made available these compounds should be handled with the same care as the lower members of the series.

Polmerization and Isomerization

The polymerization reaction forms olefinic types of hydrocarbons boiling in the gasoline range and higher.[32] The reaction physiologically to the product is essentially the same as that discussed under distillation. The catalyst, phosphoric acid on kieselguhr, is comparable in its effects to the clay and other dusty mechanical irritants discussed under catalytic cracking. Thermal polymerization is commensurate in equipment hazards to the heat and pressure given under thermal cracking and reforming.

In isomerization the butanes used as the starting material and the isomeric product have essentially the same effect on the body as the light hydrocarbons discussed under distillation. The equipment is subjected to considerable corrosive action by the hydrogen chloride used as a promotor for the reaction, particularly if moisture should accidentally be present.

The catalysts, aluminum chloride and dry hydrogen chloride, may be particularly harmful on inhalation or contact. Aluminum chloride in its crystalline state is very astringent and drying to the skin and mucous tis-

—*Courtesy American Optical Company.*

Overall of chrome-tanned cowhide leather. Protects legs and chest.

sues.[134] When contact is made with the moisture of the skin and mucous. aluminum chloride releases aluminum ions and hydrogen chloride. The former are not particularly harmful, but the latter acts as any strong acid being corrosive and irritating. As hydrogen chloride is used in the process as a promotor, the hazards are enhanced considerably from corrosive action on mucous and skin areas.

Gaseous hydrogen chloride attacks

—*Courtesy United States Rubber Company.*

The acid-oil jacket, MG-750, is made of an acid and oil resisting compound on tan sheeting.

the upper respiratory tract. The acid formed from the moisture present neutralizes the alkalinity of the tissues causing severe inflammation of the respiratory system, and may be fatal from the spasms set up in the larynx (chokes to death).[86] In the eyes, the conjunctiva is burned and reddened and the edges of the eyelids may be inflamed.[50]

When mixtures of the type used in the isomerization reaction, i.e., chlorine and hydrocarbons, come in contact with the skin there may be acute inflammation characterized by itching and burning, followed by a persistent chloracne. This is denoted by pustular eruptions and cystic lesions.[61, 115, 132]

First aid consists of wiping the aluminum chloride fom the skin first with a dry cloth, and then washing the area with plenty of water. If dilution is started first, the heat from solution can cause deep burns. Hydrogen chloride should be immediately washed fom the area with plenty of water both for eyes and skin. Whenever the men are required to load aluminum chloride into reactors, or to open lines where hydrogen chloride is

present, face masks with air supplied respirators should be worn as well as rubber or neoprene gloves and suits to protect them from corrosive fumes and dust.

Dehydrogenation

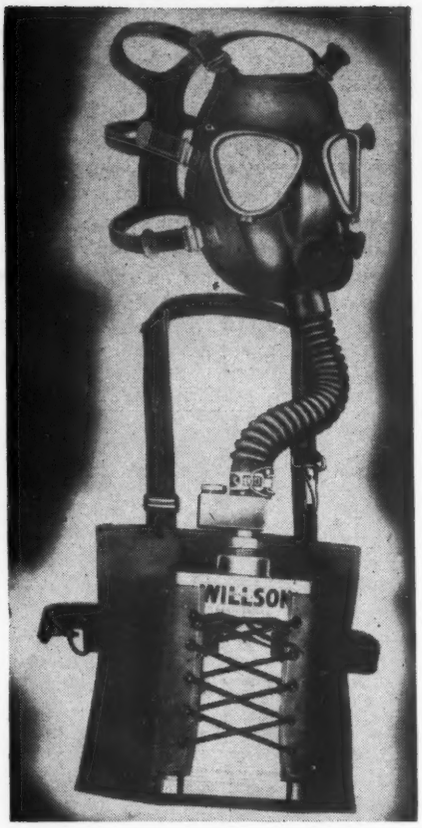
When dehydrogenating butane the products butene and butadiene react on the body in a manner similar to the light hydrocarbons previously discussed. Operating conditions are no more hazardous than those shown under catalytic cracking. However, the chromium contained in the alumina-chromia catalyst is a source of toxicity both on inhalation and contact.[36]

Inhalation of dusts from chromium compounds cause nasal irritation, inflammation of the nasal mucous tissues, nose bleed, and with continued exposure, perforating ulcers of the nasal septum.[26, 107, 137, 143] The throat and mouth are also affected on inhalation and the following symptoms appear progressively: many small ulcers on the soft palate and surface of the tongue and floor of the mouth, drying and cracking of the back of the tongue with enlargement and reddening of the buds; drying and crusting of the tonsillar region are also present after massive exposures, or those of long duration.[26, 97]

The earliest symptoms of chromium toxicity are sneezing, excessive secretion of tears, and a profuse and watery nasal discharge. Other symptoms that may follow are labored breathing, choking sensations, dizziness, weakness, and headaches. The recommendations show that chromium compounds in the air should never exceed 0.1 mg per cubic meter of air in any working area.[113, 116]

When hands and other exposed portions of the skin come in contact with the chromium compounds, deep and painful ulcerations known as "chrome holes" develop slowly. The skin may be entirely removed, particularly at the knuckles and the base of the nails. The tissues show scars when the scab is sloughed. In addition to dermatitis some individuals have developed allergies consisting of asthma, fever, nephritis, and the like.[88]

First aid consists of removing the inhalation victim from the chromium containing atmosphere as soon as possible and calling the doctor. Should any untoward symptoms—sneezing, bleeding nose, skin ulcerations, and other signs of poisoning develop, a doctor should be consulted. If the eyes receive any dust, they should be washed for at least fifteen minutes with plenty of water, as the eye reactions parallel the skin reactions very closely and blindness may gradually develop through ulcerative attack on the layers of the cornea.[53] Protective equipment consisting of goggles, respirators, rubber gloves, and aprons should be worn when this type of catalyst is being handled in loading and unloading areas.



Mask assembly.

Spat of chrome-tanned cowhide leather. Protects ankle and instep. Easily adjusted at top and under instep by snap fasteners. Immediate release in one swift motion.

Alkylation

The hazards of the alkylation processes are mainly those from the catalysts. One process utilizes sulphuric acid to bring about the reaction and the other uses hydrogen fluoride. Of the two the hydrogen fluoride is the more dangerous.

Sulphuric acid is irritating and corrosive on either inhalation or contact. If inhaled, it attacks the upper respiratory tract. In sufficient quantity it may cause death from edema of the lungs or spasm of the larynx, and inflammation of the upper respiratory tract.[80] For first aid call the doctor promptly.

The dangers do not derive from inhalation, however, to as great an extent as from splashes on the skin and in the eyes. Concentrated sulphuric acid on the skin feels oily and there is only a slight sensation of warmth with some itching. The characteristic features of these burns are the color changes of the skin and the absence of blistering. Pain is not severe except in eye burns; however, the burn may be deep and infection is likely to be greater than in other types of burns because of the likelihood of contamination during first aid, and the devitalization of the tissues.[59]

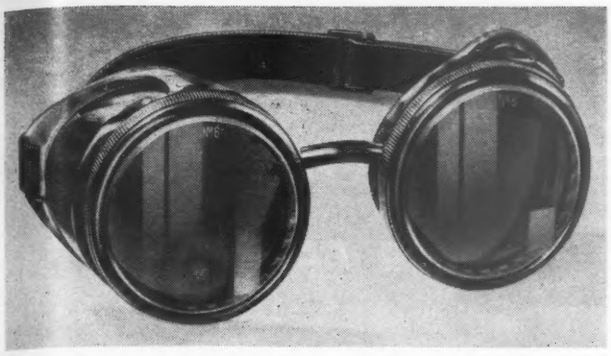
In the eyes sulphuric acid is dangerous and painful.[55, 74] Splashes or droplets cause conjunctivitis; inflammation of the cornea, resulting in opacity; scarring; and perhaps adhesion of the eyelids to the eyeball.

First aid for skin contact consists of removing acid-soaked clothing immediately and then bathing the area with large quantities of water for at least 15 minutes.[34, 157] A deluge shower is recommended for this purpose.[34] Body burns should be given medical attention promptly. For eye contacts, a fountain delivering a soft stream of water is best.[34] The water should be used immediately for at least 15 minutes and an ophthalmologist consulted immediately afterward on the conclusion of water washing.[75, 117, 103, 152]

Protective equipment consists of splash proof goggles, acid hoods, gauntlet type rubber gloves, rubber aprons, boots, coats, and sleeves. Warning notices should be posted where sulphuric acid is being handled.[34]

Hydrogen Flouride—HF. The use of hydrogen fluoride as a catalytic agent resulted in six fatalities during 1944 and 1945. Operators and maintenance personnel were involved.[15, 16]

Hydrogen fluoride is violently toxic. One lungful is sufficient to cause death. It irritates all tissues with which it comes in contact. Inhalation may pro-



—*Courtesy American Optical Company.*

Duraweld goggles recommended for acetylene welding, cutting, burning, brazine and furnace operations. Protects against injurious light rays, glare, flying sparks and scale.

Rubber-frame goggle recommended for protection against chemical splashes, spray, impact of foreign particles and exposures to fine dust concentractions on the following operations: work by maintenance men on acid lines; repairing and maintaining storage batteries; working on metal plating baths; cleaning and degreasing, etc.

duce vomiting and rapid collapse. In low concentrations hydrogen fluoride fumes produce inflammation and ulceration of the conjunctivae, the mucous membranes of the nose, mouth, larynx, and bronchil. As little as 10 ppm has caused ulcerative lesions and broncho-pneumonia. In lower concentrations for short periods, except for a temporary cough and considerable tears, which passes off in fresh air, the fumes are apparently harmless. [62, 123] The maximum allowable concentration of hydrogen fluoride for prolonged exposure is approximately 3 ppm. Prolonged and repeated exposure to mildly irritating concentrations seems to decrease sensitivity to the fumes.[121]

Symptoms of non-fatal hydrogen fluoride inhalation poisoning consist of acute stomach upset with sudden nausea and vomiting, burning in the abdomen, and diarrhea. Pulmonary edema (pneumonia) is an outstanding characteristic symptom.[27] The body changes caused by this reagent are principally blood, lung, liver, and kidney damage. The lungs and liver show the most consistent and severe damage from hydrogen fluoride absorption.[128]

When sufficient hydrogen fluoride is absorbed to be fatal, death may occur in a few minutes or be delayed for ten hours or longer. Alternating spasms and paralysis are present prior to death with general weakness and sluggishness between spasms. There is a fall in blood pressure, general collapse, and sometimes the skin shows a grayish-blue coloration. Breathing is difficult and may be arrested. The heart action may also be stopped.[127]

The bone structure is changed as a result of chronic hydrogen fluoride absorption, as it is stored in the bones. Movement of the spinal column is restricted, and parallels other bone changes that consist of overgrowth of the bone and calcification of the ligaments. Bony fragility is also seen in some of the chronic cases. The bony overgrowth tends to stop when exposure ceases.[27]

Loss of appetite, nausea, vomiting, and heartburn are common symptoms of chronic poisoning. Rheumatic attacks, shortness of breath, and circulatory changes are also experienced.[128]

Skin contacts with hydrogen fluoride are painful and lead to deeply penetrating ulcers. The primary difficulty lies in the fact that the hydrogen fluoride may be on the skin for a considerable period before any indications of burning are felt. When burning is sensed, the penetration of HF into the tissues is already deep, and the resulting sores continue to eat into the tissue long after the hydrogen fluoride is supposedly removed from the area. Activity of the fluorine ion is responsible for this reaction.[41] First aid consists of washing the area thoroughly and applying magnesium oxide paste to absorb the fluorine ions.[41] A doctor should be consulted promptly to prevent further difficulties.

The eye membranes react to hydrogen fluoride showing slow ulceration of the conjunctival; the initial reaction being one of excessive lachrymation. Chronic eye reactions are abnormal sensitivity to light and a continuous conjunctival secretion. The eyes must be bathed copiously (15 minutes or longer) when any reaction to HF occurs, and a physician consulted as soon as possible to prevent further difficulties.[62]

Personal protection consists of wearing air supplied respirators, and gloves, shoes, coat, or overalls of impervious neoprene coated materials. Face masks or goggles must be of material that does not react to fluorine, as ordinary glass is etched and dissolved by hydrogen fluoride.

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Analysis of Methods of Determination of Water Dew Point in Hydrocarbon Gases*

FRED C. RIESENFELD† and HENRY D. FRAZIER‡

BECAUSE of the considerable importance of the control of water content of gas streams, and the wide applicability thereof as just outlined, there are a great many installations in operation which reduce such water content to some degree. The successful control of such operations depends upon suitable methods for determining the water content of the treated gas stream, and it is the purpose of this paper to discuss such methods and their significance.

The reduction of the water content of natural gas has been accomplished in general by three methods. One of these methods consists of the use of solid absorbents such as calcium chloride, lithium chloride, magnesium perchlorate, calcium sulphate and others. These materials, in general, are non-regenerable in place and must be removed from the contact vessel and regenerated or discarded.

The second type of dehydration process utilizes solid adsorbents such as activated alumina and silica gel. These materials are somewhat more economical in large operations since they can be regenerated in place by the use of high temperature gas or steam.

The third type of dehydration process, which at present is most widely used in large operations, employs hygroscopic organic liquids such as diethylene glycol, or diethylene glycol-ethanolamine mixtures. Diethylene glycol is used where dehydration alone is needed and glycol-amine mixtures where acid gas removal is desired in the same operation.

Any of the dehydration processes requires analytical control and a number of methods and instruments has been developed to give an indication of the water content of the treated gas.

Two types of these instruments are so designed that the actual operation is intended to give an indication of the temperature and pressure at which the first liquid water will drop out of the gas. This temperature and pressure is commonly referred to as the dew point. Before the advent of liquid dehydrating processes this dew point could be used without further interpretation in cases involving the temperature of formation of natural gas hydrates since the latter cannot form without liquid or solid water present, even though the temperature be below the hydrate formation point. For this reason we find the efficiency of dehydrating processes expressed in terms of "dew point depression."

One such type of instrument maintains a constant system pressure and manipulation involves the lowering of the temperature to the point of formation of a visible film, or droplets, on a highly polished cool surface. The temperature at which the first darkening of the surface occurs is taken as the dew point. This kind of instrument may be referred to as the "temperature variant type." The most commonly used instrument of this type is the Bureau of Mines apparatus for determining the dew point of gases under pressure, described by W. M. Deaton and E. M. Frost, Jr.,[3] (Fig. 1).

Another such type of instrument for the determination of the dew point or water content utilizes an essentially adiabatic expansion from a predetermined pressure and ambient temperature to produce a visible fog in the gas when the predetermined pressure has been set just above the dew point pressure. This type can be referred to as the "pressure variant type" in that it determines a pressure at which a liquid phase will form at the temperature of the cell.

A good many methods may be placed in a third class. These include types which rely upon some property of water, other than the condensation phenomenon, which is different from the properties of the other compounds present. Todd and Gauger[13] offer a method in which the water content of gas is determined by infrared spectroscopy. Dunmore[4, 5] and Weaver and Riley[14] describe procedures utilizing

RIESENFELD

THE AUTHORS

Fred C. Riesenfeld is an Austrian-born graduate of the University of Vienna with degrees the equivalent of bachelor of Science in chemistry. He was employed during the period 1937-44 by the General Hospital, Vienna, for clinical analyses; University of Paris and Nanterre General Hospital, on new laboratory methods, later with Harold L. Simons, Inc., in the manufacture of organic chemicals. He joined Fluor in 1944 for general chemical research, pilot plant work, gas analyses, research on corrosion of metals, and commercial plants testing, in which work he is at present engaged.

FRAZIER

Henry D. Frazier, research chemical engineer for Fluor Corporation, slipped into the petroleum industry via Shell Development Corporation in 1939, and received a bachelor's degree in 1940 from the University of California in chemistry physics and biochemistry. Consolidated Engineering of Pasadena, California, employed him for mass spectrometric work, design of high vacuum equipment, leak detection, and related vacuum techniques until 1944, when he joined Fluor to design and operate pilot plants, carry on field service in gas purification and dehydration plants, and general service work in the solution of a wide variety of industrial plant problems.

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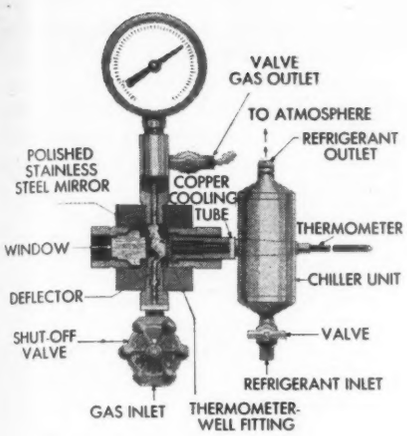

FIG. 1. Bureau of Mines dew point indicator.

the variation in electrical conductivity of a hygroscopic film with varying amounts of water absorbed at different water partial pressures in the gas. Several methods involving chemical reactions specific for water are reported in the literature. Among the chemicals used are cobalt bromide,[9] Karl Fischer[6] reagent, which consists of a methyl alcohol solution of iodine, sulphur dioxide and pyridine; magnesium nitride[10] and a mixture of acetyl chloride and pyridine.[12, 7] Russell, Reid and Huntington[11] in their work on vapor-liquid equilibria between natural gas and 95 per cent diethylene glycol absorb water and glycol vapor on anhydrous magnesium perchlorate and determine the glycol separately by oxidation with potassium dichromate.

All of these instruments and methods are quite satisfactory for most gas streams that have been dehydrated by means of the first two methods previously mentioned above. If the gas has been treated with glycol or glycol-amine mixtures, however, these methods may not give results capable of interpretation in terms of true water content.

The electrical conductivity type instrument may be used with some degree of success on gas streams contacting diethylene glycol only but it is not usable on those effluent from glycol-amine dehydrating plants, because amines are also conductors of electricity.

This discussion is directed primarily toward the pressure variant and the temperature variant types of instruments, as they are in the most common use in the field. As the phenomenon encountered in their use on liquid dehydrated gas streams is essentially the same with either type of instrument, we shall use the temperature variant type—in particular the Bureau of Mines dew point indicator—as an example. The instrument does not yield a true water dew point and the value obtained is not accurately indicative of the water content of a gas which has been in equilibrium contact, with a diethylene glycol or diethylene glycol-monoethanolamine containing solution.

The reason for this conclusion is based on the following theoretical considerations. The gas leaving the top of the contactor of a glycol or glycol-amine plant has approached equilibrium with the solution at the top tray, and is therefore essentially saturated with a mixture of glycol, amine, and water vapors in proportion to their respective partial pressures at the

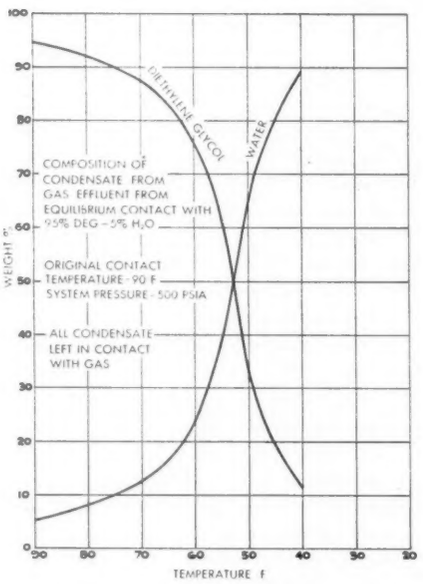

FIG. 2. Condensate due to cooling of dehydrated gas.

pressure and temperature conditions prevailing at this point; any change in temperature or pressure will disturb this equilibrium. If the temperature of the gas stream is lowered an infinitesimal amount under true equilibrium conditions, a small quantity of liquid of essentially the same composition as that which the gas last contacted will condense. Thus, in the customary use of the dew point indicator a film of liquid will appear on the mirror at some temperature lower than the equilibrium temperature at the top of the contactor. The temperature at which this liquid becomes visible to the eye of the operator will depend to a great extent upon the rate of cooling and technical manipulation, particularly since such systems may be subject to super-cooling, but in no event can this liquid consist solely of water, for it will always contain components of the liquid treating system—glycol, amine and water, or glycol and water. Since this condition prevails, it is quite obvious that the observed so-called "dew point" obtained is not an index of the water content of the gas stream and cannot be made to be such, since under properly controlled equilibrium conditions for making such measurements, liquid will condense continuously on the mirror of the apparatus as the temperature is lowered, and this condensate will have a continuously varying composition. The first material condensed will have very little water and be mainly glycol and amine. This liquid does not readily form a fog but is likely to spread evenly over large areas of the mirror and be unnoticed during the first phases of the operation.

Fig. 2 shows the variation of the composition of the material which will constitute the liquid phase on the surface of a mirror which is being cooled in a stream of gas that has been passed through a glycol-water dehydration system utilizing a solution of 95 per cent diethylene glycol, 5 per cent water operating at a contact temperature of 90 F, and a pressure of 500 psia.

Fig. 3 shows the same data for a dehydrater solution containing 70 per cent diethylene glycol, 25 per cent monoethanolamine and 5 per cent water. These curves were arrived at by equilibrium condensation calculations in 5-10 F intervals. They indicate quite clearly that in such systems a gradual condensing of liquids of steadily changing composition occurs as the temperature is lowered. It is

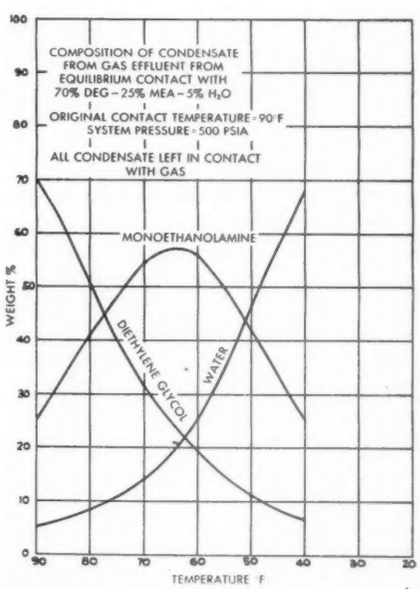

FIG. 3. Condensate due to cooling of dehydrated gas.

FIG. 4. Absorption apparatus.

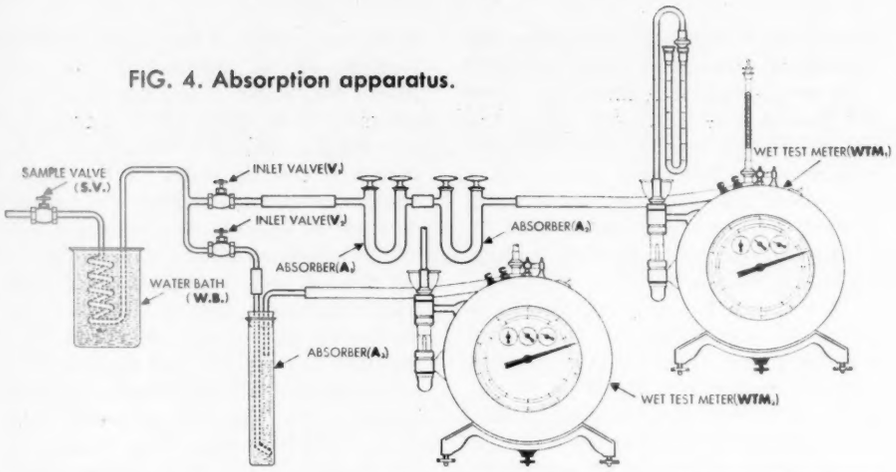

TABLE 1.

Gas Pressure Psia	Gas Temperature °F	LIQUID COMPOSITION WT% DEG	WT% MEA	WT% H_2O	Lb of H_2O Per MMSCF	*Equivalent Dew Point °F	Determined Dew Point °F
300	100	97.9	....	2.1	14.9	30	46, 47
600	103	75.4	19.2	5.4	20.0	52	58
600	110	77.6	17.0	5.4	23.9	59	53, 55
1000	85	97.2	....	2.8	4.8	24	26, 39
1000	100	97.0	....	3.0	7.2	35	28, 34

*Calculated from "WATER CONTENT OF NATURAL GAS," (Fig. 7).

therefore apparent that no distinct water dew point, dew point of any pure liquid, or liquid mixture exists unless the original contact temperature is considered to be the dew point. Several references[3, 11] have been made in the literature to the difficulties encountered in using these dew point indicators and some special techniques have been proposed to make possible some sort of useful indication with them, but all such attempts are simply compromises in an attempt to get an indication without regard for the fact that such an indication is theoretically inaccurate.

In the light of the above considerations, data have been obtained in this laboratory and in the field in an attempt to determine the absolute water content of hydrocarbon gas streams effluent from such dehydraters. The method finally adopted for this work was based on the method proposed by Russell, Reid and Huntington,[11] with slight corrections.

The equipment required for the method is shown schematically in Fig. 4. It consists of a sample valve, S.V., on the gas line to be sampled, followed by a water or steam bath, W.B., for the purpose of heating the gas before dropping the pressure into the absorption system. Following this water bath are the two absorption trains.

The first absorption train, for the removal of total vaporized liquid, consists of the valve V_1, preferably a 1/8-in. needle valve, the two glass absorption tubes A_1 and A_2, and the wet test meter WTM_1. The absorption tubes A_1 and A_2 are glass U tubes 100 mm long and 15 mm inside diameter with stopcocks at the inlet and outlet ends.

The second absorption train, for the removal of amine, consists of the valve V_2, also a 1/8-in. needle valve, the absorption tube A_3 and the wet test meter WTM_2. The absorption tube, A_3, is a large test tube closed with a two-hole neoprene stopper carrying the gas inlet and outlet tubes. The gas inlet consists of a small fritted glass gas dispersion tube of 20 mm diam such as is manufactured by the Corning Glass Works; extra coarse plates (Type EC) are preferably used in order to prevent too high a pressure drop across the plate. An absorption bottle such as described by the California Natural Gasoline Association[1] can also be used advantageously. Any suitable gas meter calibrated to 0.001 cu ft or 0.01 liter can be used for the measurement of the effluent gas, although a wet test meter is recommended.

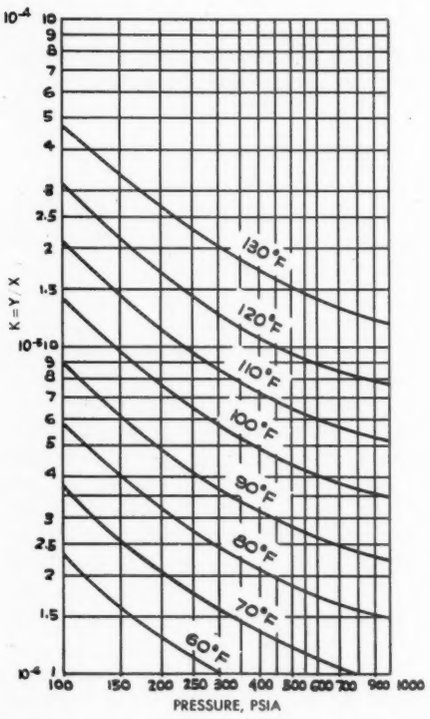

FIG. 5. Vapor-liquid equilibrium chart for determining diethylene glycol.

The necessary reagents are:

Anhydrous magnesium perchlorate (Anhydrone)

0.02 N sodium hydroxide

0.02 N sulphuric acid

Methyl red indicator (0.1 per cent in water)

Determination of total vaporized liquid: The two absorption tubes A_1 and A_2 are filled with anhydrous magnesium perchlorate and purged with gas for a period of 15 min. This is necessary to saturate the magnesium perchlorate with hydrocarbon and thus to prevent erroneous results caused by hydrocarbon absorption. The tubes are then weighed on an analytical balance to an accuracy of 0.1 milligram and subsequently placed on the line in the same order as when purged. A_1 is connected to V_1 and A_2 to WTM_1; the connections should be made with short lengths of neoprene tubing. The flow is started by opening valves S.V. and V_1; S.V. should be opened several turns so that full line pressure is maintained through the water bath to valve V_1, which is used as a throttling valve for flow rate control. The flow should be regulated so that a maximum of 6 cu ft per hr is maintained. After passage of a maximum total of 18 cu ft, the gas is shut off, the tubes disconnected and again weighed on the analytical balance. If the analysis is run properly, the increase of weight of the second absorption tube should not exceed 5 per cent of the increase in weight of the first tube.

Determination of amine: Absorption tube A_3 is filled with 50 ml of 0.02 N sulphuric acid, using either a calibrated pipette or burette, the gas inlet is connected to V_2 and the gas outlet to WTM_2. The flow is started by opening V_2 and the flow rate is adjusted to a maximum of 6 cu ft per hr. Care must be taken not to pass the gas at too high a flow rate in order to avoid liquid losses by entrainment. After passage of a maximum total of 18 cu ft of gas the flow is stopped and the sulphuric acid is transferred to a 250 ml wide mouth Erlenmeyer flask. The tube A_3 is rinsed several times with small amounts of distilled water which are also added to the flask. The amine is subsequently determined by titrating the excess sulphuric acid with 0.02 N sodium hydroxide using methyl red as the indicator.

Determination of diethylene glycol:

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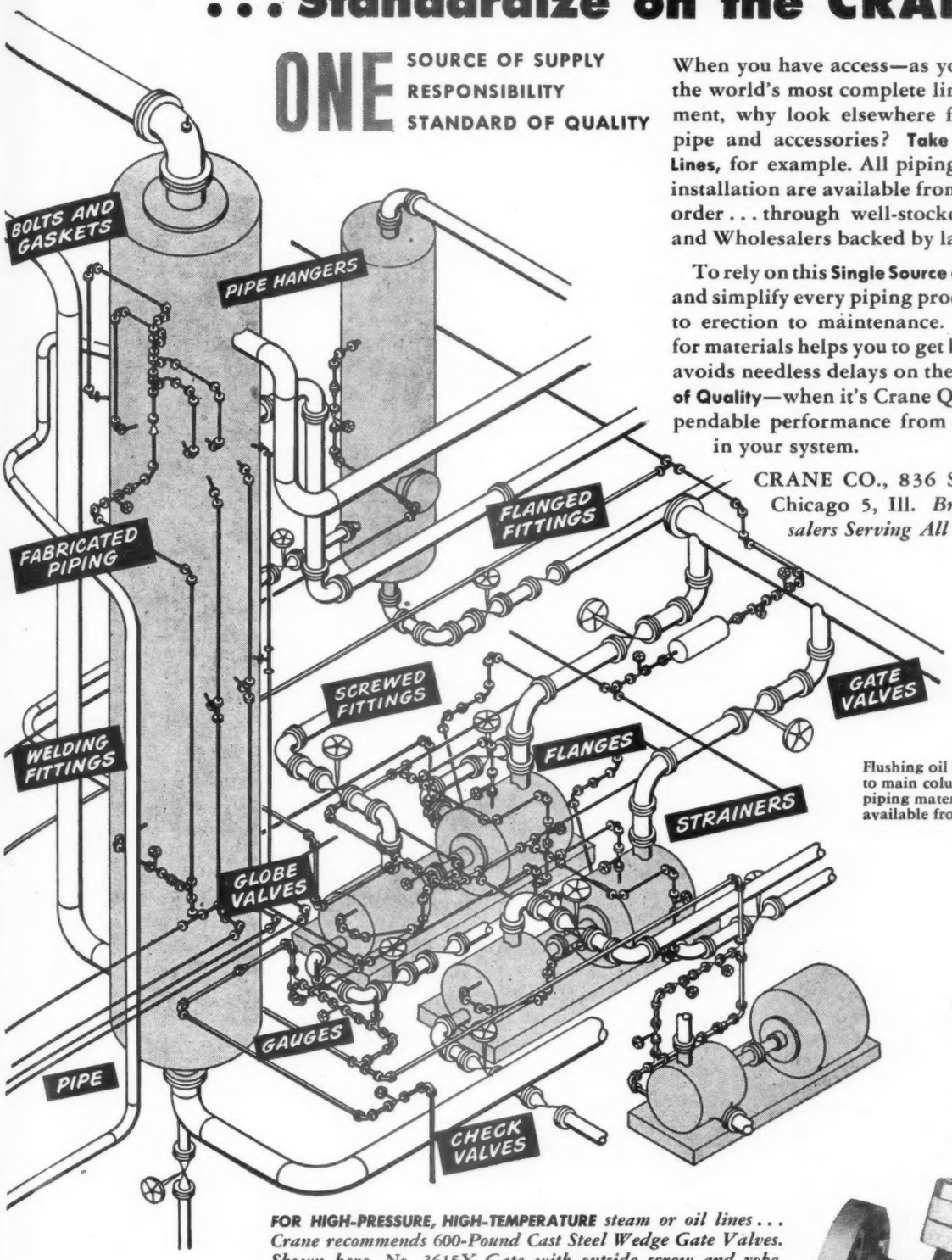

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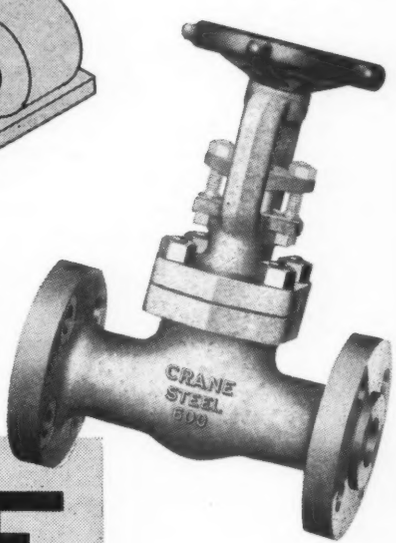

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The diethylene glycol content of the gas is determined by calculation, using the equilibrium chart shown in Fig. 5.

Care should be taken that S.V. is opened sufficiently so that the system is under full line pressure up to V_1 and V_2.

The absorption tubes A_1 and A_2 should be watched for change in color and accumulation of liquid. As soon as a yellow coloration or the appearance of droplets of liquid on the walls is noticed, the tubes should be emptied and loaded with fresh Anhydrone. Also if A_2 shows a weight increase larger than 5 per cent of the weight increase of A_1, the latter tube should be reloaded.

This method is not designed for separate analyses of the individual vaporized liquids since only the monoethanolamine is determined directly. Because the amount of glycol vapor present in the gas is, however, of the order of magnitude of 5 per cent or less of the total vaporized liquid, the use of an equilibrium chart for its determination is justified.

The procedure described above is designed for the analysis of gas at 500 to 1000 psig, which is the operating pressure range commonly encountered in glycol-amine treating plants. If the gas to be analyzed is at lower pressures, and therefore larger amounts of vaporized liquid are carried by the gas, the amount of gas used for an analysis should be decreased accordingly. However, the maximum figures of 6 cu ft per hr and 18 cu ft of total gas passed should not be surpassed at any set of conditions.

This method can also be used in dehydration plants employing diethylene glycol-water solutions. For such a system the analysis is simplified by omitting the second train for the absorption of the amine. The total vaporized liquid is determined by absorption on anhydrous magnesium perchlorate and the glycol vapor calculated from the equilibrium chart. The water content is found by subtraction of the glycol from the total vaporized liquid.

Fig. 6 presents data collected in this laboratory employing diethylene glycol-water and diethylene glycol-monoethanolamine water solutions in contact with hydrocarbon gas at different pressures and temperatures, following, in general, the method described above. The figure compares the experimental data obtained with a chart constructed partly from the data of Russell, Reid and Huntington,[11] and partly from information published by the Carbide and Carbon Chemicals Corporation.[2] Table 1 shows dew points as actually indicated with the Bureau of Mines dew point indicator

CALCULATIONS

The gas volume read on the meter is corrected to standard conditions.*

$$\text{corrected volume SCF} = \text{observed volume CF} \times \frac{(460+60) \times P \times (P-P_W)}{(460+t) \times 30 \times P}$$

t = observed temperature, °F.
P = observed pressure, inches of mercury.
P_W = vapor pressure of water at observed temperature, inches of mercury.

1. Total vaporized liquid:

$$\text{grams of total vaporized liquid/SCF} = \frac{(W_2-W_1)+(W_4-W_3)}{SCF}$$

*Standard conditions: 60°F., 30.0 inches of mercury, dry.

W_1 = weight in grams of A_1 before test.
W_2 = weight in grams of A_1 after test.
W_3 = weight in grams of A_2 before test.
W_4 = weight in grams of A_2 after test.
SCF = corrected gas volume.

If the result is desired in lbs. of total vaporized liquid/MMSCF; lbs. of total vaporized liquid/MMSCF = 2.2 x 10^3 grams of total vaporized liquid/SCF.

2. Monoethanolamine vapor:

$$\text{grams of MEA vapor/SCF} = \frac{(V_1 \times N_1 - V_2 \times N_2) \times 0.0611}{SCF}$$

V_1 = ml of H_2SO_4.
N_1 = normality of H_2SO_4.
V_2 = ml of NaOH.
N_2 = normality of NaOH.
lbs. of MEA vapor/MMSCF = 2.2 x 10^3 grams of MEA/SCF.

3. Diethylene glycol vapor:

The diethylene glycol vapor in the gas is calculated from the attached equilibrium chart (Fig. 5).

For any given temperature and pressure:

$$K = \frac{Y}{X}$$

the solution of which may be obtained from the chart.
K = equilibrium constant, read from the chart for the operating conditions.
Y = mol fraction of diethylene glycol vapor in gas, the quantity which it is desired to evaluate.
X = mol fraction of diethylene glycol in liquid, which may be obtained from the following equation:

$$X = \frac{\dfrac{\text{weight \% DEG}}{106.1}}{\dfrac{\text{weight \% DEG}}{106.1} + \dfrac{\text{weight \% MEA}}{61.1} + \dfrac{\text{weight \% } H_2O}{18.0}}$$

Then:

$$Y = K \times \frac{\dfrac{\text{weight \% DEG}}{106.1}}{\dfrac{\text{weight \% DEG}}{106.1} + \dfrac{\text{weight \% MEA}}{61.1} + \dfrac{\text{weight \% } H_2O}{18.0}}$$

$$\text{grams of DEG vapor} = \frac{Y \times 106.1}{0.8366} = Y \times 126.8$$

lbs. of DEG vapor/MMSCF = 2.2 x 10^3 grams of DEG/SCF.

4. Water vapor:

grams of H_2O vapor/SCF = W_T/SCF − (W_A/SCF + W_G/SCF).
W_T = weight of total vaporized liquid.
W_A = weight of MEA vapor.
W_G = weight of DEG vapor.
lbs. of H_2O vapor/MMSCF = 2.2 x 10^3 grams or H_2O vapor/SCF.

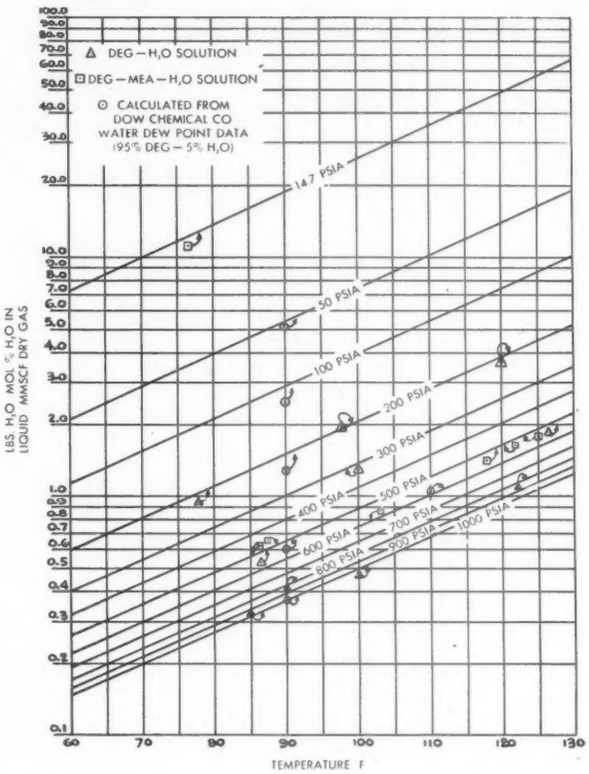

FIG. 6. Water content of gas from liquid dehydration systems.

compared with the dew point temperature corresponding to the experimentally found water content of the gas stream as calculated from the data of McKetta and Katz[8] (Fig. 7). The discrepancies between these two temperatures are quite obvious.

It can be seen from the foregoing discussion that the glycol and amine vapors are a definitely measurable proportion of the total vaporized liquid in the equilibrium gas stream. Since it is well known that the injection of any water soluble material, such as an alcohol, has a considerable depressing effect on the formation temperature of hydrates, it is obvious that the presence of glycol and amine vapors in the gas stream would have a similar action. Since in many instances, and particularly those involving natural gas transmission systems, the objective of gas dehydration is to prevent hydrate formation and subsequent stoppage of pipe lines, any means which depresses the hydrate formation temperature is desirable. Furthermore, in such cases where the gas stream contains organic liquids, the water content of the stream is no criterion of the temperature at which hydrates are formed and therefore determination of so-called "dew points" and water content cannot be correlated directly with the hydrate forming temperature.

It is interesting to note that a major pipe line operator, employing a liquid dehydration system, has operated continuously throughout the coldest winter conditions encountered for many years without a single freeze of a line. This in spite of the fact that the temperatures in the line were considerably below the calculated water dew point of the gas entering the line and therefore hydrate formation was to be expected.

As the liquid that condenses from the gas has an increasing amount of water carried with it as it condenses (Fig. 3), the equivalent water dew point of the gas is always below the actual temperature of the gas as long as the condensate is allowed to stay in contact with the gas. If the gas mentioned previously in connection with Fig. 3 from the glycol-amine plant were cooled to 60 F, the dew point calculated from the original water content (original equivalent water dew point 38 F) would be lowered to 36 F. If it is cooled to 50 F the equivalent water dew point is lowered to 34 F and if it is cooled to 40 F the residual water is sufficient to yield an equivalent water dew point of only 28 F. Therefore it becomes a question of the hydrate forming temperature of the condensate only which at 40 F has 67 per cent water, the balance being glycol and amine. It appears to the authors that the dehydration of gas by liquid absorbing agents should be evaluated rather by the actual water content of the gas thus treated than by the dew point depression which is commonly used at present. Although a slightly more complicated and time consuming analytical procedure is probably not justified for routine control, it is felt that it is indispensable in cases where a performance guarantee of equipment is involved.

It should be remembered finally that, although we have referred occasionally to phenomena occurring after the gas leaves the plant, this discussion is concerned primarily with analytical tools and methods and not with the theoretical or actual composition of condensates in pipe lines or

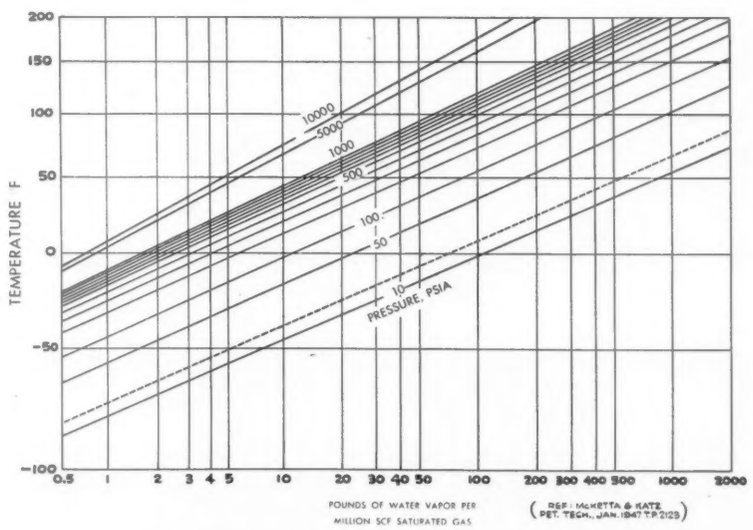

FIG. 7. Water content of gas.

even the presence or absence of them. Changes of pressure must also be considered along with changes of the temperature since the vapor carrying capacity of a given gas varies rapidly with varying pressure and therefore this discussion has been confined to treating and dehydration systems in which the pressure is assumed to be constant.

Conclusions

1. Theoretical and experimental considerations indicate that the determination of the water content of gases evolving from liquid dehydrating systems cannot be determined by the use of the conventional dew point determination equipment.

2. Experimental and calculated figures show that gases evolving from dehydrating plants using liquid dehydrating agents carry condensable vapors other than water which constitute a considerable portion of the total condensable liquid content of the gas stream.

3. An analytical method for the determination of the actual water content of gases effluent from liquid dehydration systems is presented.

4. In the light of the preceding conclusions, it may be presumed that the hydrate formation temperature of such gas streams would be considerably lower than that which would be indicated solely by the water content of the gas stream.

5. Rating of the efficiency of dehydration equipment has the sole purpose of allowing control of the water content of the effluent gas stream at a low enough value that the water content of the condensate will not allow hydrate formation at the temperatures expected in the pipe line. Therefore the authors believe that the rating of such equipment should be based upon the actual water content and not on the dew point of the gas.

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★ ★ ★

C. F. Sanderson at pilot plant.

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Oxidation of propane under controlled conditions to produce acetaldehyde is the chief reaction employed in a new process which has been under development at Texas A. & M. College by C. F. Sanderson, Ph. D. graduate in June. The work has been done under a Gulf Oil Corporation graduate fellowship. Employing an unnamed catalyst propane from natural gas is oxidized to acetaldehyde.

The new process is reported to be simple, with relatively little of the side reaction products which complicate the purification of oxidation products from natural gas when made by older oxidation processes. It is understood that additional process development will be carried along this line by the chemical engineering department of A. & M. at College Station.

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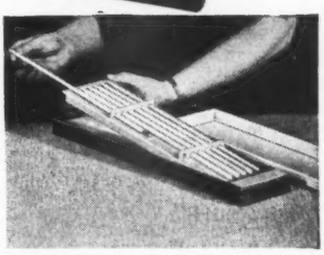

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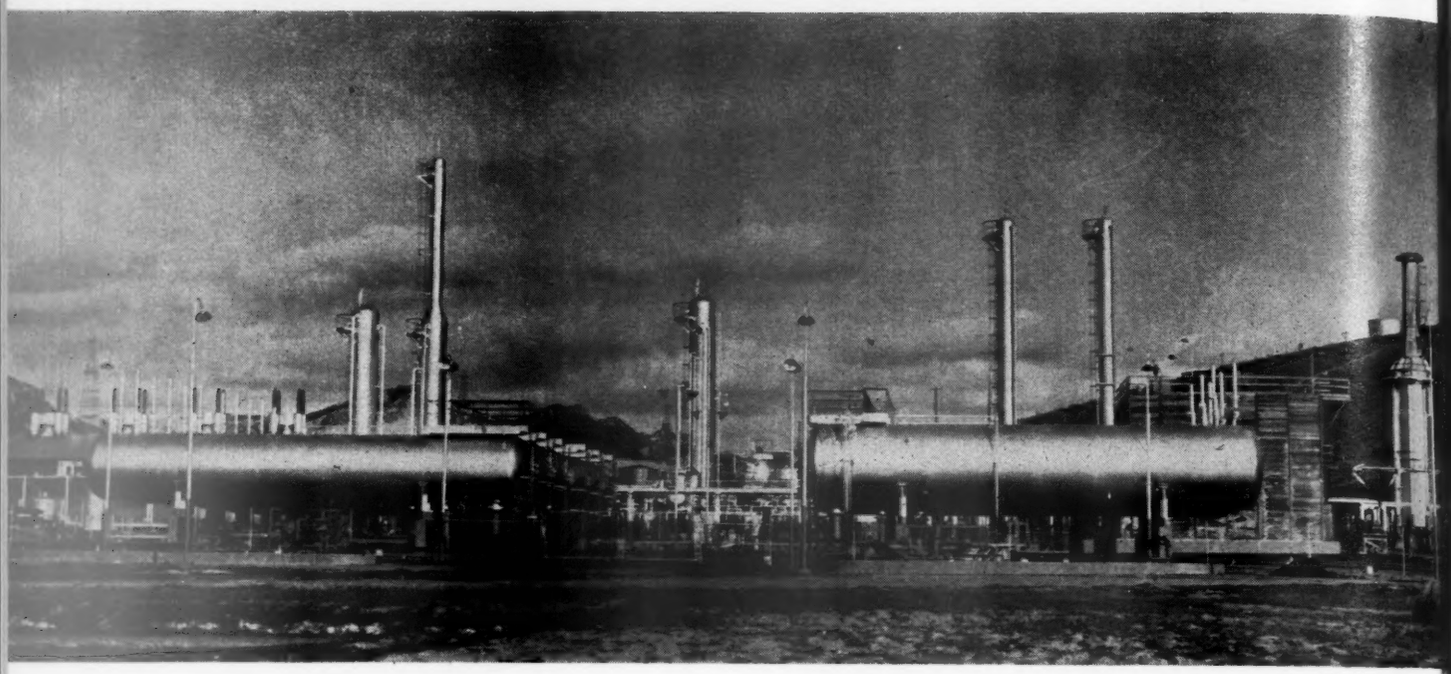

Barnsdall's Newhall-Potrero gasoline plant, California.

Gasoline Plant Emphasizes Compactness

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Emphasis on compactness and saving of heat stand out in this newest plant of the Barnsdall Oil Corporation at Newhall, California. Absorber and reabsorber are installed in the same tower construction. Hot lean oil is employed largely to transfer heat to various fractions and charge stocks. Large amounts of liquefied petroleum gases, butane and propane, are recovered in the operation. Stripped gas is returned to producing horizons at about 200 psig.

In the Purple Sage of the old Spanish Grant, Rancho San Francisco near Newhall, where some of the oldest wells in California still produce oil, Barnsdall Oil Company recently completed one of the most interesting natural gasoline plants operating in Southern California. Building this gasoline plant was decided upon because a sustained drilling program discovered a number of separate and progressively deeper zones containing oil sands. To maintain flowing conditions at the eighty odd producers, the program included returning all of the gas back to the formation through selected input wells at a maximum average pressure of 2000 psig at the tubing head of the input wells. The gasoline plant was designed to process 40,000,000 cu ft of gas daily in a single high pressure absorption column operating at 450 psig. The percentage extraction of propane may vary over a wide range because of factors encountered in gasoline plants, such as the available market, etc.

Practically all of the wells on this lease are operated with enough back pressure to deliver the gas through the gathering system and bypass the compressors directly to the absorber. Various groups of wells flow into conveniently located separator batteries for double trapping so that the most of the gas is removed at the first stage. Smaller volumes are taken from the second stage of separation at 60 psig, and still smaller but progressively richer volumes of the gas are recovered from flow tanks, which are boosted to about 60 psig with small individual compressors at each battery of separators and flow tanks. This low pressure gas is staged up to 450 psig to blend with the main stream of field pressure gas at the header feeding the gas to the absorber and auxiliary equipment.

Gas at production delivered pressure and that which is boosted from a lower pressure to absorption requirements is cooled in two horizontal shell and tube exchangers. These exchangers, set as near the base of the absorber as practicable, are supplied with headers and manifold gates to allow parallel operation or to facilitate cleaning as either of the two may be cut out of service without disturbing the functions of the one left in the circuit. The fouling factor for these two coolers was calculated to provide ample and adequate temperature control under adverse day-time conditions when the atmospheric temperature runs high in mid-summer afternoons. The absorber itself is a more or less conventional high pressure vessel, 6 ft by 48 ft, containing 20 bubble plates and utilizing an absorption oil of about 150 molecular weight. This oil is pumped to the top of the column at rates that vary with the percentage of propane extraction desired, but average 10 gal per 1000 cu ft of gas processed. The gas flows from the shell and tube water-

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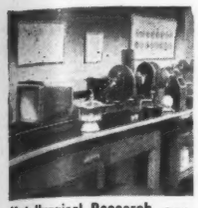

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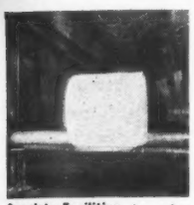

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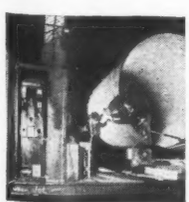

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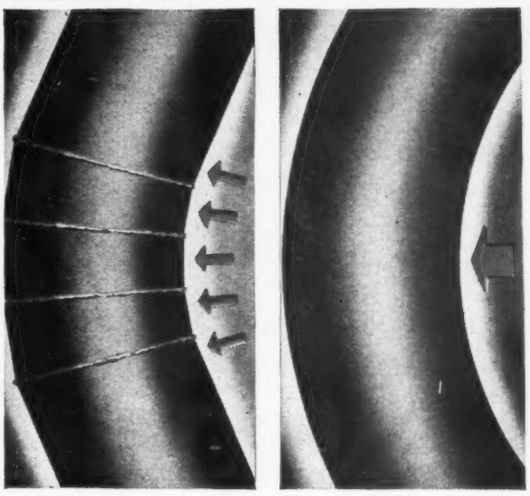

In process pipe larger than 30" in diameter, bends have customarily been made by welding segments together (left). The irregular contour of such bends increases erosive effects of flowing material through successive, abrupt changes in direction of flow. Similarly, corrosion problems are intensified where these sharp changes in direction of flow set up eddies and pockets of corrosive material. Smooth, precisely contoured ONE-PIECE bends reduce erosion and corrosion to a minimum.

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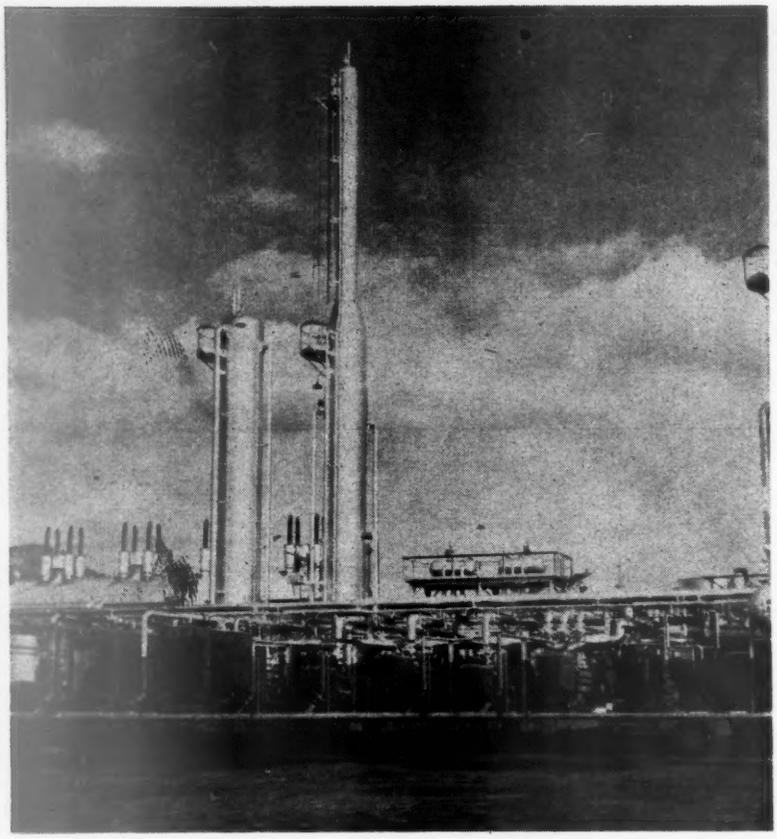
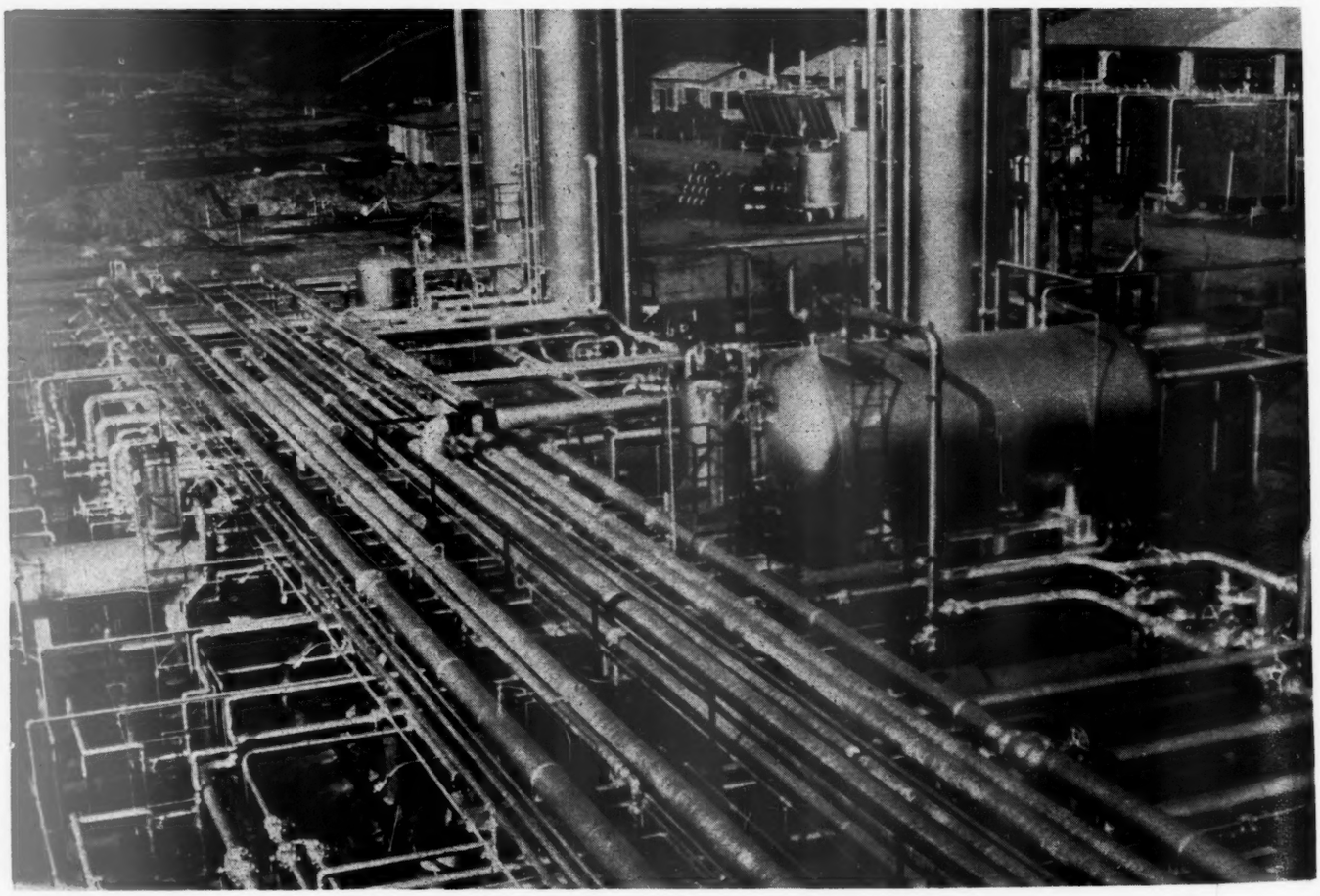


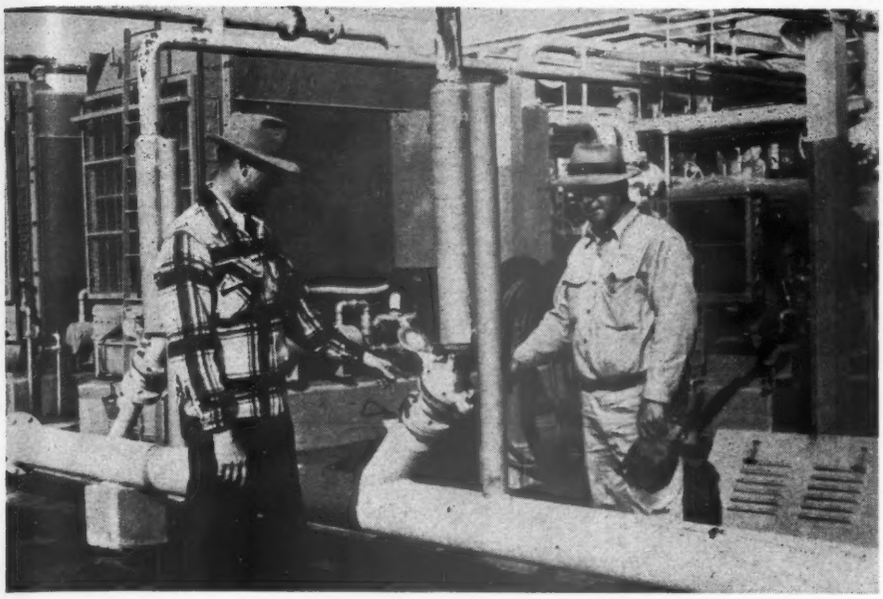
Double-duty combination absorber-reabsorber tower at Newhall.

serviced cooling units to the absorber and, after stripping, is released through a pipe line at the top. The gas is conducted to a scrubber and mist extractor before entering the engine room where it is staged to the higher pressure required for reservoir control. No gas is released to the atmosphere through flares, and none is used for any purpose other than fuel for engines and the normal gasoline plant and field production requirements. Thus, natural resources are conserved to the maximum extent by cycling and formation pressure control.

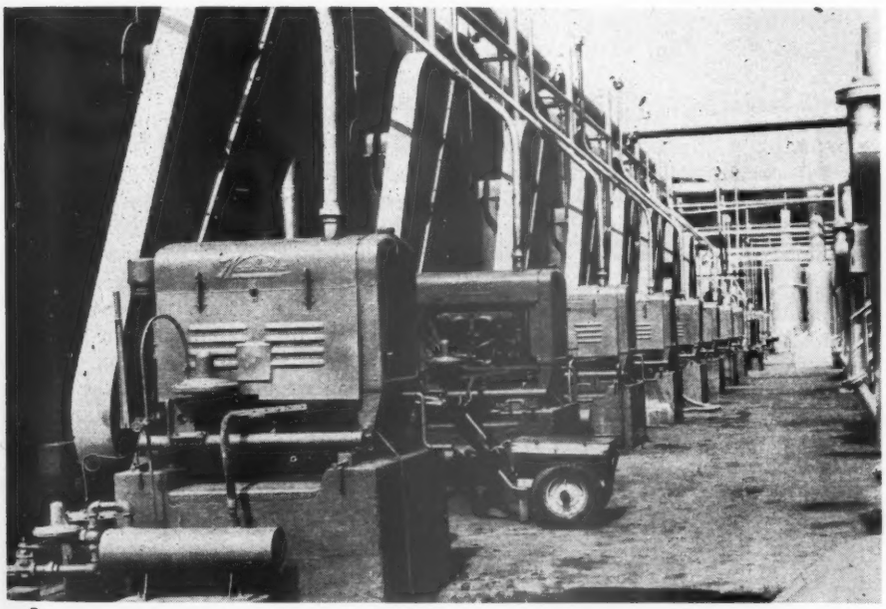
The rich absorption oil, which has extracted all of the desired hydrocarbons from the gas at 450 psig while in contact in the absorber, is released through adequate liquid level control instruments into a short, inverted U-shaped transfer line, fashioned to elevate the piping above ground and to remove an obstruction at knee-level, so that men can pass freely and safely about the equipment. In order that succeeding equipment in this gasoline plant will not be loaded with undesirable hydrocarbons—ethane and methane dissolved in the absorption oil—the downstream end of the transfer line is connected to a combination column operating as a deethanizer and

The complicated piping system is placed overhead, so that easy access is afforded to all ground-level units.

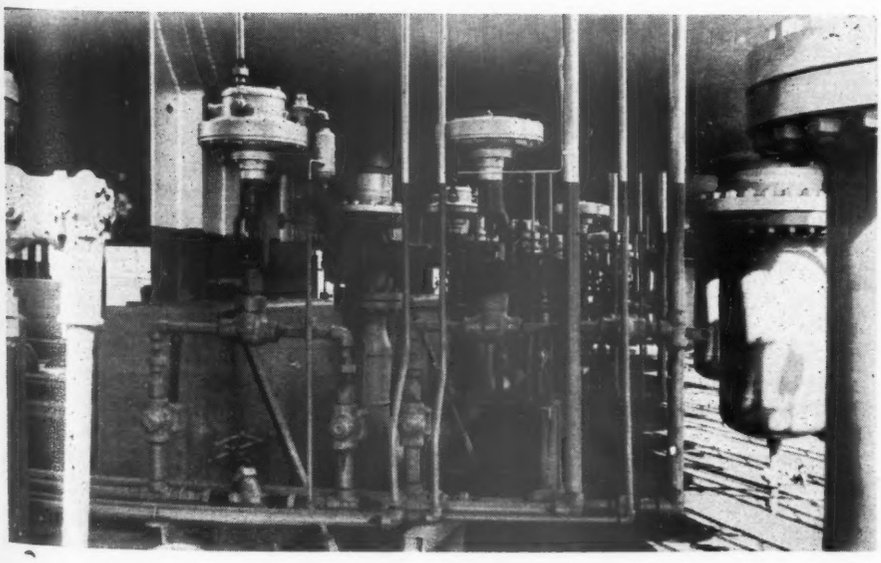




Nova Upshaw, plant foreman, and Clarence DeWebber, head operator, of plant.



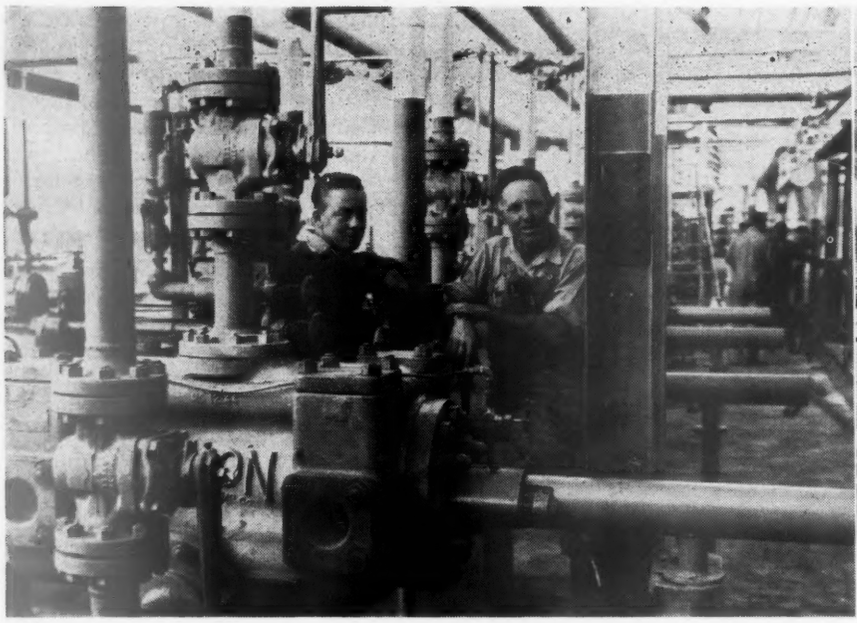
Waukesha gas engine powering blower fans in the cooling unit.



Diaphragm valves maintain various controls in the Barnsdall plant.

reabsorber. This column, for all practical purposes, is a set of two columns, one superimposed upon the other; the deethanizer set on the concrete pier at ground level, and the reabsorber set on top of the deethanizer. The lower section has a cross-section diameter of 5 ft 6 in., and the top section 3 ft, with a combined height of 78 ft 6 in.

The bottom section consists of several separate sections having vertical dividing walls and draw-off pans so that the cold lean oil will enter at the top of one section for flashing part of the entrained ethane from the oil about 175 psig. The upper end of the top section is open and connected directly through an inlet flume to the bottom of the reabsorber, or top section; therefore, all of the material released from the cold oil travels upward into the top column. In the ingenious section of the bottom column into which the cold oil flows, there are a series of stripping trays and pans that lead the oil in succession to the bottom part of the section from which it is removed by liquid level instruments into a line connected to transfer pumps. These pumps direct the cold oil through heat exchangers to raise the temperature so that the oil can be returned to the bottom section of the column; it enters a separate compartment where it is flashed again over stripping trays. From the base of this section, the oil again is removed through level controls to be transferred to a second set of pumps which direct it through other exchangers where hot, lean oil raises the temperature to about 400 deg, when it again enters the deethanizer into a third, and separate section at the initial pressure of about 175 psig. Vapors released from the oil in the three deethanizing steps commingle at the column top where they enter the upper section; here some of the heavier fractions are recondensed and drop back into the oil. Fractions leaving the bottom section as vapors flow upward through bubble trays to the top where they come in contact with cold, lean absorption oil at a rate of about 50 gal per min. This oil reabsorbs propane and heavier fractions to be included in plant production in succeeding operations. The rate of flow of the cold lean oil to the top section of the combination column can be easily changed to recover more or less of the propane released from the rich oil



A. T. Mitcham and Willard Sorrels in absorption and distillation unit.

R. H. Humphrey, compressor room operator.

while it is being passed through the various compartments of the bottom section. If a greater extraction percentage of propane from the gas is desired in the absorber, the rate of flow of the absorption oil is increased, which may or may not require a greater volume of cold lean oil to the top section of the combination column, termed the reabsorber.

As all of the extraneous and undesirable low-boiling fractions are eliminated from the stream of rich oil while it passes through the various sections of the deethanizer, it follows that the desirable hydrocarbons are processed through succeeding equipment for total condensation and all separate cuts are recovered as liquid for ultimate disposition as salable products. When hydrocarbons leave the outlet of the reabsorber as vapors, they flow through piping that leads to the fuel supply for the direct fired heater where the rich oil is processed. However, if the volume of such vapors exceeds the requirement of this heater, the excess is bypassed into the low pressure suction of the compressor room to be boosted back to the required pressure for injection into the selected input wells of the production control program. Before the top discard vapors are reduced in pressure for fuel in the vertical heater, they are utilized for the pressure at which they are released to drive all of the reciprocating steam-type commodity and service pumps. To prevent an icing condition from hydrate formation in power cylinders, ports, and slide valves, this discarded gas is passed through a heat exchanger countercurrent to a quantity of hot lean oil. By this exchange the vapors are heated to a point that will keep the cylinders warm and assist with lubrication, and the hot lean oil is reduced in temperature.

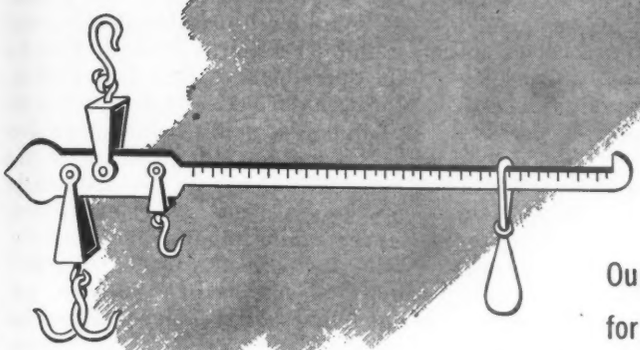
As the pressures in both the top and bottom sections of the combination column are equal, the rich oil from the final outlet of the lower section and the absorption oil released from the draw-off pan at the base of the top, or reabsorber section, both can be collected as a composite commodity in a drum from which pumps take suction for delivery to the direct-fired heater tubes. A temperature of about 500 F is applied to the rich oil in the heater so that efficient stripping can be obtained in the still, or rich oil fractionator. The column employed to strip the rich oil of its absorbed hydrocarbons is more or less conventional in design and operation. It has a cross section diameter of 5 ft 6-in. and a height of 49 ft and contains 18 stripping and fractionating bubble plates. An adequate volume of steam is produced in a waste heat boiler to assist in stripping the rich oil in the still. Vapors removed from the oil flow in conventional manner to the top where they are quenched with reflux to maintain the desired end point. A pressure of about 100 psig is held on the still so that the overhead product can be totally condensed in water-serviced exchangers. The liquid product is released into an accumulator from which the still reflux is obtained by pumping.

All of the condensate is then pumped from the still reflux drum to the next column in the process where the propane is fractionated as an overhead product, totally condensed as such, and directed to proper storage. The depropanizer column bottoms recirculated in a reboiler is stripped of its load of propane before being released to the third column. The depropanizer is 3 ft by 68 ft-6 in. and is operated in a manner similar to any other depropanizer to obtain the desired results. As the plant has a plentiful supply of hot oil leaving the still to impart required heating, hot. lean oil, instead of steam, is employed to maintain the required temperature in the reboiler and the base of the column.

Bottoms from the depropanizer is pumped to the third column from which two cuts are made, the overhead varying in percentages of iso- and normal butane, depending on the vapor pressure and grade of natural gasoline produced as a bottom product. Butanes from the outlet of the debutanizer column are condensed and flow through water coolers to proper storage as LPG. Bottoms are cooled and sent to low pressure natural gasoline storage.

Steam at 150 psig is produced in the plant without conventional boilers. A system of horizontal heat exchangers, vertical piping, and elevated collector drums make use of the 500 F lean oil from the still to generate a sufficient volume of steam to be used in processes. Water for steam generation is collected from various points

How "heavy" is resourcefulness?



Ours would weigh nearly four billion pounds, for that's how much Attapulgus Fullers Earth and Porocel Activated Bauxite we've shipped to petroleum refiners.

When weighing resourcefulness—as it applies to percolation adsorbents and solid catalysts—two factors are particularly meaningful: First, the desire of all the people in the company family to tackle problems that require particular skill and broad technical knowledge. Second, the company's physical reach—mines, plant equipment, specialized laboratory and engineering facilities—for good men can do no more than their tools permit.

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in the plant and pumped through the exchangers countercurrent to the flow of hot oil with makeup supplied from plant water treated to zero hardness. Two identical units are installed for parallel operation and either or both may be on stream, or one taken out for maintenance without disturbing the operation of the other. After the lean oil is used for heating in the various phases of gasoline plant operation, it is collected in a common header and directed through a fin tube aerial cooler and finished for temperature control in shell and tube exchangers.

Water Supply

The plant water is obtained from wells some distance from the plant. This water is treated and cooled in a two-cell induced draft tower having a capacity of 2000 gal per min. The cooling tower is designed as a two-cell unit for a practical purpose. If either cell should become fouled and require cleaning, it may be shut off without disturbing the operation of the other. Moreover, men who may work inside the tower to remove algae and collected dust are not exposed to drafts of water and can work comfortably without rain suits. The cooling tower is designed to handle 93 F plant water, cooling it to 75 F under atmospheric conditions indicated by a 65 deg wet bulb.

A large number of installations were made in the plant to provide ease of operation and safety for the men working around the equipment. For example, instead of feeding solid lubricants into plug valves, these pieces of equipment are supplied with nipples so that a pressure gun can be used to facilitate the periodic job of servicing the moving parts. All of the gate, plug, and globe valves are set into lines where the men may reach them easily without using a stool, bench, or ladder. Control valves and automatic devices are set in such position that they may be serviced easily to do this, adequate safety ladders and landing platforms are installed with ample space for a man to work without being cramped for room. As a protection for both the employes and the plant facilities, no cast iron valves or flanges are installed, and all vessels and major units in the plant are supplied with ground wires to drain away static so as to prevent a damaging spark.

The main control room of the plant is located in its 'mid-section', constructed of steel and especially treated aluminum sheets that reduce glare. The recording and controlling instruments in this room are grouped six to a panel with a large area-way behind the board for servicing. Thermocouples are installed for instant determination of temperatures at any part of the plant, and the instruments are such that any definite point under observation can be plugged to a recorder.

Tankage of all grades of liquid products are mounted upon high cradles so that fittings and connections can be reached easily. The tank into which the plant is 'making' cannot be overfilled with a spill because of liquid level instruments that sound a high level alarm in ample time for the operator to make a switch. If unforeseen difficulties come about in the plant that prevent attention, the valves set in motion other equipment that automatically bypass the vapors to the low pressure gas gathering systems.

The engine room of the plant contains approximately 6000 hp to gather low and intermediate pressure gas, and to boost all residue to the pressure required for production reservoir control. Each engine is supplied with individual radiator type jacket water coolers, but all coolers are interconnected so as to provide a wide margin of cooling. This plant was built by Refinery Maintenance Company. ★★

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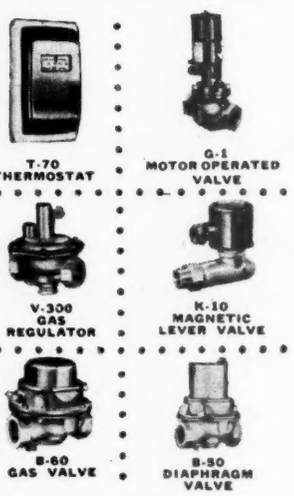

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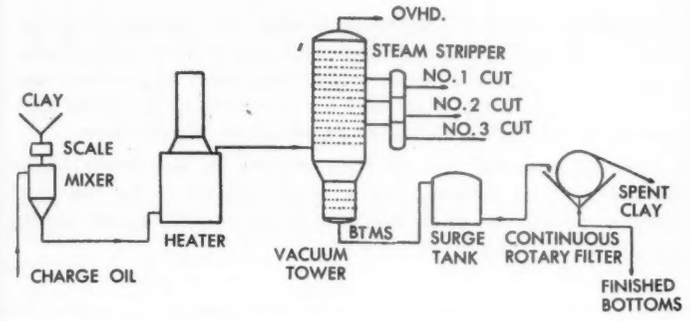
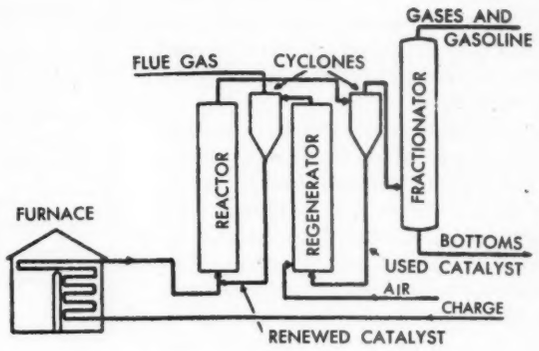


FLOW DIAGRAM OF FRACTIONATION PLANT



FLUID CATALYTIC CRACKING PROCESS

Important Filter and Catalyst Materials Are Manufactured in Mississippi

ARCH L. FOSTER*

Two of the most important mineral products employed by the oil refining industry are mined and processed in Mississippi, at the Filtrol Corporation's plant at Jackson. These products are filter media, "clays" as they are generally called, catalysts and/or catalyst carriers.

At present catalysts, and especially cracking catalysts, are among the most important agents used by the refiner. All cracking catalysts used in practical, commercial installations today are composed chiefly of the oxides of various metals, such as silica or silicon dioxide, SiO_2, main constituent of sand, alumina or aluminum oxide, Al_2O_3, magnesia or magnesium oxide, MgO, chromia or Cr_2O_3, and sometimes other metal oxides are used in varying percentages, as promoters or catalyst aids. Two general types of catalysts are made: (1) The 'natural' type of metallic oxides or their mixtures—more generally—in which the naturally occurring raw material is mined, processed to remove the larger amounts of impurities and to form it in the shape of dust or powder, pellets, or other forms desired by the user; (2) the synthetic catalyst is made customarily by the precipitation of the metal oxide or hydroxide from a water solution of its salt, drying, pulverizing, pelleting either alone or more often by combination with another oxide. Such catalysts are formed also into powder, 'Beads' or Microspheres for use in different cracking processes.

Cracking and other reactions carried out by bringing hydrocarbon liquids or vapors into contact with so called "adsorption contact agents" are called heterogeneous catalytic reactions. Such agents include the metal oxides mentioned, among many others. The chemical combination called montmorillonite, which is a hydrated compound of aluminum, silicon and oxygen, is credited with the formula $Al_2Si_4O_{10}(OH)_2:nH_2O$. In the natural mineral, chemists find that about one-sixth of the aluminum is replaced by magnesium, which brings three metals into the material, all of them among those mentioned above as catalytically active for cracking reactions. The negatively charged crystals absorb metal oxides for neutralization, which are replaced by hydrogen during 'activation' of the raw material to the very active hydrogen montmorillonite, the basis for the catalyst of commerce and industry.

Since catalysis is considered by many scientists to be a surface phenomenon, the greater the amount of surface exposed the more active the catalyst. Greater surface is obtained by increasing the subdivision of the material, and by increasing the pore size.

Pelleted type catalysts are employed in the Houdry catalytic cracking process, the pioneer process among those that have attained commercial success; also in the TCC (Thermofor Catalytic Cracking) process, which employs a so-called moving-bed system. The catalyst pellets pass downward slowly through a reaction vessel while vapor or liquid of the charge stock passes through the mass in either countercurrent or concurrent direction, and the catalyst is withdrawn continuously from the vessel for regeneration, by burning off the carbon deposited on it with a mixture of hot air and inert gas. The Houdry

*Refining and Gas Processing Editor.

EXCLUSIVE

process holds the catalyst in fixed beds, and introduces regenerating air, and charge vapors, alternately to maintain the catalyst's reactivity and produce cracked products over a long period of time.

In the fluid type catalytic cracking process the catalyst, whether synthetic or natural, is divided finely, up to 200-mesh or finer, and is 'blown' with a current of charge stock vapors or carried by liquid into a reactor that contains a large bed of catalyst. Passing through the bed the charge is cracked, and the spent catalyst, with its deposit of carbon is 'blown' through catalyst-recovering equipment to the regenerator where carbon is burned off as explained above.

Other uses for adsorptive contact agents include the highly important and much older methods of filtering light and heavy liquid products for the removal of color, resinous and other undesirable bodies. Still another use of these materials is as a polymerization catalyst for the removal of olefins, diolefins and other unsaturated products from cracked or straight run light products, to improve color, oxidation stability and remove gum-forming materials.

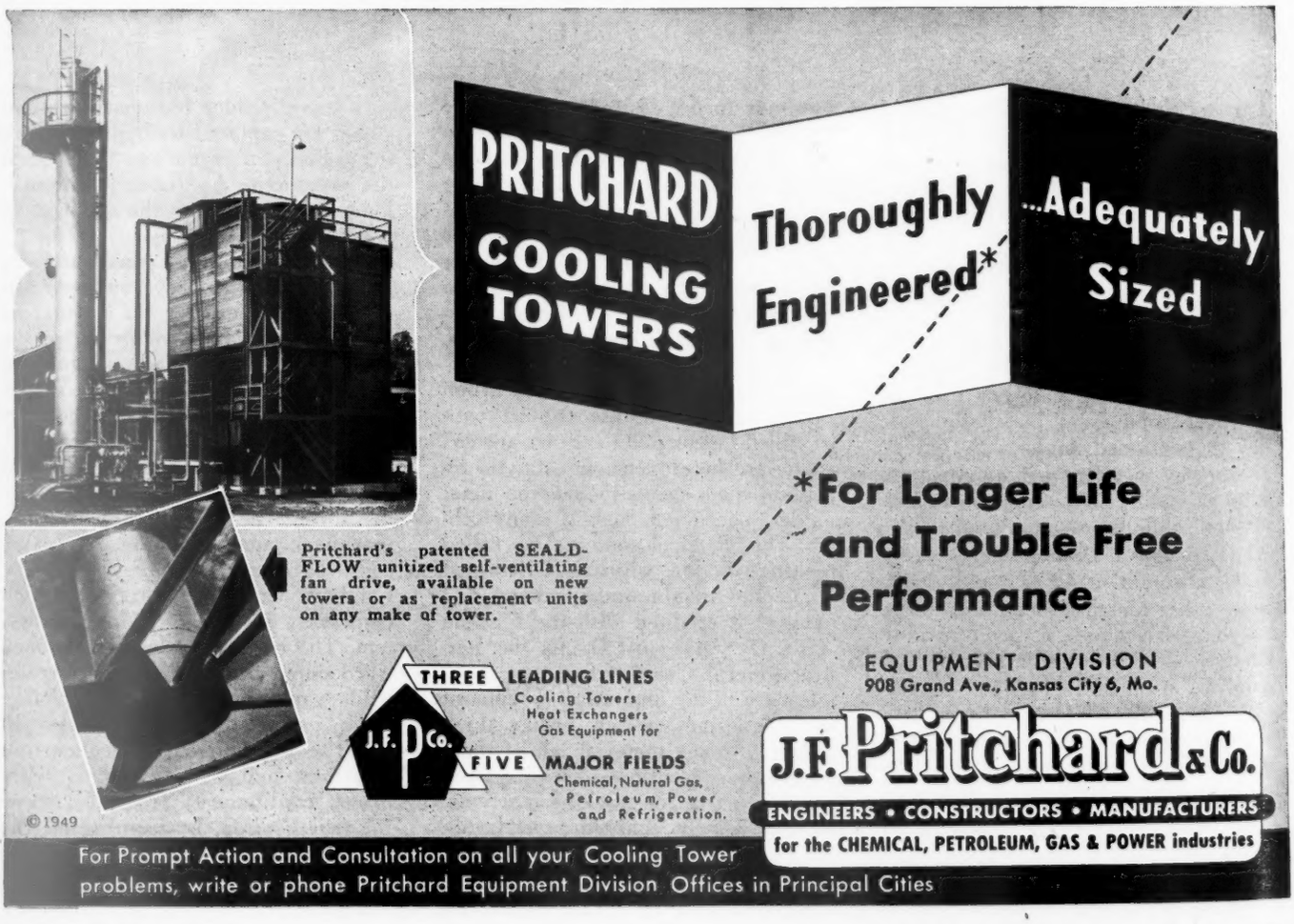
Filtration of lubricating oil and paraffin wax stocks is carried out in two ways, by contact filtration in which the oil and finely divided 'clay' are mixed and filtered at generally elevated temperatures through filter presses or centrifugal equipment to remove the filter medium with its load of impurities. Another method is by percolation filtration, by which the oil to be treated flows downward or upward as desired through a fixed bed of granulated filter material such as Filtrol or fullers earth, to remove color and other bodies.

In filtering by contact, the customary method is to mix charge oil and filter medium 'clay' by established means, pass the slurry through a coil or other heater and into a filter unit by which the clay is removed. Various types of treatment are given the filtered oil later, usually removing light diluent if the oil has been diluted with naphtha to 'cut' its viscosity to aid more rapid filtration. A variant of this system is the mixing of clay and oil, passing it through a heater and into a fractionating column at high distilling temperature. The heavy undistilled residue, with the clay, is drawn off the bottom of the tower and separated by filtration as already outlined. The vaporized fraction may be divided into any required number of streams, for any desired purposes. Many variations of these processes are in use or have been used. * * *

Lubricants Immune to Temperature

Fireproof lubricants which do not thicken with cold nor thin from the heat of an engine may find important applications in military and civilian uses. Fluorcarbons, which are chemical compounds containing carbon and gaseous element, fluorine, were discussed by scientists at a recent conference sponsored by the Office of Naval Research in Washington.

Chemists foresaw possible use of fluorcarbons as lubricants under extreme conditions, such as in flaming-jet aircraft engines or for the small gyroscopes on gun mountings which are now being run at higher speeds than they were during World War II.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New Standards Adopted by ASTM

A LARGE number of standard test methods were revised, adopted, and assigned for further investigation by Committee D-2 of the American Society for Testing Materials during its 1948-49 year, one of the busiest in the history of the Society. These actions include the recommendation for adoption of six new or revised standard methods to Committee Z-11 of the American Standards Association. These include:

Cone Penetration of Lubricating Grease D 217-47 T; ASA No. Z11.3-1948,

Sulphated Residue, Lead, Iron and Copper in New and Used Lubricating Oils D 810-47 T; ASA No. Z11.57-1948,

Chemical Analysis for Metals in Lubricating Oils D 811-44 T; ASA No. Z11.56-1948,

Sediments in Fuel Oil by Extraction D 473-46 T; ASA No. Z11.58-1948.

Reapprove as Revised American Standards:

Standard Definitions of Terms Relating to Petroleum D 288-47; ASA No. Z11.28-1948,

Standard Method of Test for Knock Characteristics of Motor Fuels by the Motor Method D 357-47; ASA No. Z11.37-1947.

Withdrawal of Standard Method of Test for Tetraethyl lead in Gasoline, D 526-42; ASA No. Z11.42-1942, is recommended.

Six methods were recommended to be published for information:

Test for Micro Cone Penetration of Lubricating Greases,

Test for Apparent Viscosity of Lubricating Greases,

Definitions, Functions, Types, and Designations of Cutting Fluids,

Carburetor Jacket for Use with Motor and Research Methods to Rate High Vapor Pressure Fuels,

Test for Color Index of Petroleum Products by Photoelectric Colorimeter,

Test for Sulphur in Petroleum Products by the CO_2-O_2 Lamp Method with Supplement.

Twelve methods were recommended for adoption as tentative, including:

Acetylene in Polymerization Grade Butadiene by Silver Nitrate Method,

Oxygen in Butadiene Vapors by Manganous Hydroxide Method,

Peroxides in Butadiene by Ferrous Titanous Method,

Separation of Residue from Butadiene,

Butadiene Dimer in Polymerization Grade Butadiene,

Nonvolatile Residue of Polymerization Grade Butadiene,

Sodium in Lubricating Oils and Lubricating Oil Additives,

Measurement of Freezing Points for Evaluation of Purity,

Determination of Purity from Freezing Points,

Total Olefinic and Aromatic Hydrocarbons in Gasoline,

Hydrogen in Petroleum Fractions by the Lamp Method,

Benzene and Toluene by Ultraviolet Spectrophotometry.

At the same time, at the Atlantic City meeting in June, six tentative standards were recommended for adoption as standards:

D 96-47 T. Test for Water and Sediment in Petroleum Products by Means of Centrifuge,

D 187-47 T. Test for Burning Quality of Kerosine,

D 664-46 T. Test for Neutralization Value (Acid and Base Numbers) by Electrometric Titration,

D 873-46 T. Test for Oxidation Stability of Aviation Gasoline (Potential Gum Method),

D 938-47 T. Test for Congealing Point of Pharmaceutical Petrolatums,

D 941-47 T. Measurement of Density of Hydrocarbon Liquids by the Pycnometer.

Eight tentative standards were recommended to be revised, as follows:

D 439-48 T. Gasoline.

D 937-47 T. Test for Penetration of Petrolatum,

D 445-46 T. Test for Kinematic Viscosity,

D 936-47 T. Test for Aromatic Hydrocarbons in Olefin-Free Gasolines by Silica Gel Adsorption.

D 665-47 T. Test for Rust-Preventing Characteristics of Steam Turbine Oil in the Presence of Water.

D 614-48 T. Test for Knock Characteristics, of Aviation Fuels by the Aviation Method,

D 908-48. T. Test for Knock Characteristics of Motor Fuels by the Research Method,

D 909-48 T. Test for Knock Characteristics of Aviation Fuels by the Supercharge Method.

Eleven other tentative standard methods were continued without revision:

D 90-47 T. Test for Sulphur in Petroleum Products by the Lamp-Gravimetric Method,

D 155-45 T. Test for Color of Lubricating Oil and Petrolatum by Means of A.S.T.M. Union Colorimeter,

D 611-47 T. Test for Aniline Points and Mixed Aniline Points of Petroleum Products,

D 808-44 T. Test for Chlorine in Lubricating Oils by Bomb Method,

D 809-44 T. Chemical Analysis for Phosphorus in Lubricating Oils,

D 874-47 T. Test for Sulphated Residue from New Lubricating Oils.

D 875-46 T. Test for Olefins and Aromatics in Petroleum Distillates,

D 892-46 T. Test for Foaming, Characteristics of Crankcase Oils,

D 939-47 T. Test for Saponification Number of Petroleum Products by Potentiometric Titration,

D 942-47 T. Test for Oxidation Stability of Lubricating Greases by the Oxygen Bomb Method,

D 943-47 T. Test for Oxidation Characteristics of Inhibited Steam Turbine Oils.

The committee D-2 also recommended that Tentative Method D 894-48 T, Test for Sulphur in Lubricating Oils, etc., be incorporated in Method D 129-44, and Designation D 894 be discontinued. The committee also recommended that Tentative Method D 940-47 T be withdrawn, which is to be replaced by two new tentative methods, dealing with measurement of freezing points.

Standard Method D 130-30, Test for Detection of Free Sulphur and Corrosive Sulphur Compounds in Gasoline, is to be revised extensively and reverted to Tentative Standard.

In addition to these actions, revisions were adopted for eight standard methods, and the revisions referred to

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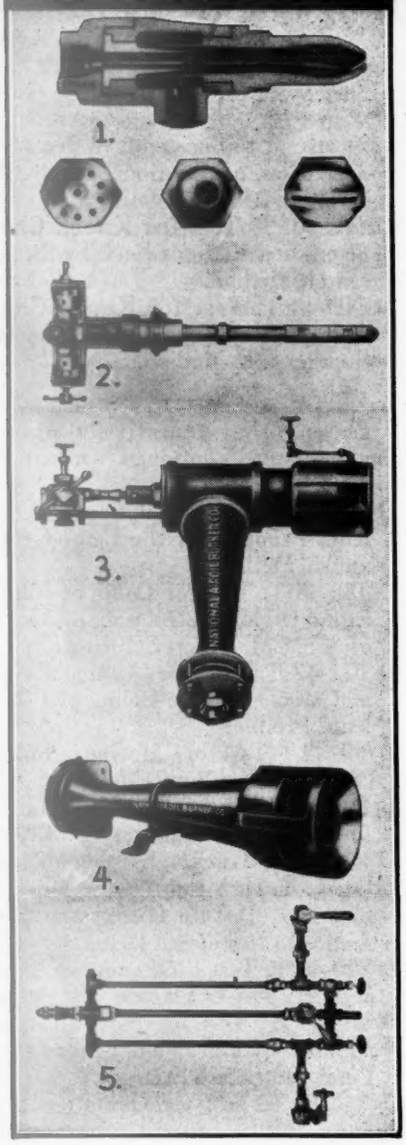

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the membership for a nine-tenths affirmative vote for adoption as part of the standard methods.

D 381-46. Test for Existent Gum in Gasoline (Air-Jet Evaporation Method),

D 525-46. Test for Oxidation Stability of Gasoline (Induction Period Method), with a revised Fig. A2,

D 323-43. Test for Vapor Pressure of Petroleum Products (Reid Method), revised,

D 357-48. Test for Knock Characteristics of Motor Fuels by the Motor Method, with the same revision as recommended for Tentative Methods D 614, D 908, and D 909,

D 127-30. Test for Melting Point of Petrolatum, revised,

D 156-38. Test for Color of Refined Petroleum Oil by Means of Saybolt Chromometer, revised,

D 129-44. Test for Sulphur in Petroleum Oils by Bomb Method, revised by the incorporation of Method D 894 and changes in Scope and Sections 3, 4, and 5,

D 288-48. Definitions of Terms Relating to Petroleum, revised.

Twenty-three standard methods were reaffirmed as standards, having been published as standards for six years or more without revision:

D 484-40. Stoddard Solvent.

D 56-36. Test for Flash Point by Means of the Tag Closed Tester,

D 87-42. Test for Melting Point of Paraffin Wax,

D 91-40. Test for Precipitation Number of Lubricating Oils,

D 156-38. Test for Color of Refined Petroleum Oil by Means of Saybolt Chromometer,

D 157-36. Test for Steam Emulsion of Lubricating Oils,

D 158-41. Test for Distillation of Gas Oil and Similar Distillate Fuel Oils,

D 206-36. Abridged Volume Correction Table for Petroleum Oils,

D 216-40. Test for Distillation of Natural Gasoline,

D 219-36. Test for Burning Quality of Long-Time Burning Oil for Railway Use,

D 239-30. Test for Burning Quality of Mineral Seal Oil,

D 240-39. Test for Thermal Value of Fuel Oil,

D 285-41. Test for Distillation of Crude Petroleum,

D 286-30. Test for Autogenous Ignition Temperatures of Petroleum Products,

D 287-39. Test for Gravity of Petroleum and Petroleum Products by Means of the Hydrometer,

D 322-35. Test for Dilution of Crankcase Oils,

D 341-43. Standard Viscosity-Temperature Charts for Liquid Petroleum Products,

D 446-39. Conversion of Kinematic Viscosity to Saybolt Universal Viscosity,

D 447-41. Test for Distillation of Plant Spray Oils,

D 483-40. Test for Unsulphated Residue of Plant Spray Oils,

D 524-42. Test for Carbon Residue of Petroleum Products (Ramsbottom Carbon Residue),

D 566-42. Test for Dropping Point of Lubricating Grease,

D 567-41. Calculating Viscosity Index.

In addition, it was recommended to publish the semi-micro Method for Oil Content of Paraffin Wax as a revision of Standard Method D 721-47, Test for Oil Content of Paraffin Wax, with the plan for replacing the text of D 721-47 by the revised method within two years. It was recommended to withdraw Standard Method D 481-39, Test for Acid Heat of Gasoline, and to publish the A.S.T.M. Manual on Measuring and Sampling Petroleum and its Products. The revised report, at Atlantic City, was submitted to letter ballot of the voting membership of 99, by W. T. Gunn, secretary of Committee D-2.

* * *

Tower Floats to Holland

Another huge all-welded steel fractionating column recently came off the production line at the Greenwich Works of G. A. Harvey.

Instead of being unceremoniously dumped off the ship's deck at its destination it was transported to a riverside jetty, where it was ceremoniously lowered into the River Thames and with tugs fore and aft was towed right across the North Sea to Holland, where it is to be erected as part of the vast extensions to the Royal Dutch-Shell refinery at Pernis, near Rotterdam.

The journey down the river and out to sea, past Southern Pier, provided a rare spectacle for those interested, and it certainly provided an unusual experience for the tug boats' crews, as never before has an oil-refiining unit—measuring over 83 ft high and weighing 108 tons—been delivered to its purchasers by this unusual method of transport under its own steam, so to speak.

It is interesting to note that the first method of transport of this column was a short distance from the Works by road transport and then it was lifted by crane into the River Thames. Two tugs took it in tow and proceeded down the river by buoyed channel, whilst overhead aircraft were in attendance.—FGB.

Selectivity!

Efficient H_2S removal in the presence of CO_2

The Shell Phosphate Process for gas or liquid purification has undergone successive improvements since its unusual advantages were first discovered.

Now it is practicable to remove all but harmless amounts of H_2S in the presence of large volumes of CO_2, while most of the CO_2 is left untouched.

The treating agent is inorganic, low in cost, and is not soluble in hydrocarbons. Since hydrocarbons being treated are not contaminated by the Shell Process treating solution, there are no harmful effects upon subsequent processing.

Regenerated H_2S is relatively pure because of its preferential removal in the first place . . . and because the inorganic treating chemical, having no vapor pressure, cannot contaminate the H_2S released in the stripper.

The Shell Phosphate Process is available to any operator under license from the Shell Development Company, Incorporated . . . together with experienced engineering service for its design, installation, and operation. Write for complete information.

SHELL DEVELOPMENT COMPANY, INCORPORATED

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SHELL

NEWS

CNGA Holds Annual Meeting

The annual meeting of the Board of Directors of the California Natural Gasoline Association was held July 2-7, at the Biltmore Hotel. William A. Kirk, California Southern Oil Company, retiring president, turned the meeting over to J. B. Taylor, Signal Oil and Gas Company, incoming president, with the presentation of the gavel. Taylor outlined some of the policies proposed for the coming year and announced his appointments of committee chairmen for the fiscal year of 1949-1950. R. S. Tulin, Shell Oil Company, Inc., was introduced as the incoming vice president of the association, and E. R. Millett, Jr., was reappointed as secretary-treasurer.

Committee chairmen are:

R. S. Tulin, advisory and gas report, L. V. Cassaday, finance and budget, Paul Armstrong, membership, A. C. Lyles, technical, Fred Hartley, fall meeting, Ernest Chipman, program, R. D. Sutherland, entertainment, Harold Bordelon, publicity.

Directors to serve for 1949-1950 are: L. V. Cassaday, Paul Armstrong, A. C. Lyles, R. S. Tulin, J. B. Taylor, R. D. Sutherland, Fred Hartley, Ernest Chipman, and Harold Bordelon.

CNGA directors to serve for 1949-1950 are: L. V. Cassaday, Paul Armstrong, A. C. Lyles. Seated, R. S. Tulin, J. B. Taylor, and R. D. Sutherland.

Sponsor Guided Tour

Announcing completion of the first continuous shale-oil refinery in this country, James Boyd, Director of the Bureau of Mines, has announced that the new 200-bbl a day experimental unit near Rifle, Colorado, will be put on exhibition September 20 and 21, the midway point in a month-long, oil shale mining demonstration.

Guided tours are planned on both days, together with a public dinner meeting at Glenwood Springs on the night of Tuesday, September 20.

Program Announced

Tentative programming of the events at this year's Pacific Chemical Exposition and Pacific Industrial Conferences, to be held in San Francisco, California's Civic Auditorium November 1 through 5, have been completed, Marcus W. Hinson, exposition manager, has announced. Highlights of the five-day industrial chemical gathering are: Talks and panel discussions under 11 separate scientific groupings; more than 100 commercial exhibits; a group of special exhibits; continuous industrial motion pictures.

Opening the Pacific Industrial Conferences—to run concurrently with the exposition—will be a symposium on Tuesday morning, November 1, on "Regional Requirements for Chemicals" under auspices of the Western Chemical Market Research Group. Rounding out events of the first day will be discussion on "Export Markets for Western Chemicals."

The remaining groups under which separate panel discussions will be held for the balance of the week are as follows: Petroleum Division, American Chemical Society (California Section), and American Institute of Mining Engineers; American Institute of Chemical Engineers (Northern California Section); Northern California Instrument Association; Pacific Insecticide Institute; Protective Coatings Group; Agricultural and Food Chemistry Division, American Chemical Society (California Section); Forest Products Research Society (Northern California Section); Northern California Rubber Group and Society of the Plastics Industry (San Francisco Section); and Pacific Association of Chemistry Teachers.

Annual Meeting Planned

Final plans have been completed for the annual meeting of the National Lubricating Grease Institute at the Hotel Roosevelt, New Orleans, Louisiana. The meeting will be held October 3-5, 1949.

"Twister Ring Greases," "Bentone Greases," "Plant for Continuous Grease Manufacture," "Steel Mill Lubrication," and "Lubrication—Then and Now," are some of the subjects that will be discussed.

Plan Gas Plant

Del Ray Petroleum Company, Houston, Texas, has let contract for construction of a gasoline plant in the Chesterville field, Colorado County, Texas.

The plant will have a daily capacity of 25,000,000 cu ft of gas. It will serve the Orange Hill field in Austin County, Lissie field in Wharton County, and Chesterville field.

Caltex Has Interest In Spanish Refinery

On June 28, Escombreras Petroleum Refinery, S.A. was organized in Spain for the completion and operation of a refinery at Cartagena, Spain. Caltex Oil Products Company, in New York, holds 24 per cent of the capital investment. The balance is held by Spanish interests: 52 per cent by the National Institute of Industry, 24 per cent by the Spanish Petroleum Company, S.A.

The capital of the new company is about 325,000,000 pesetas ($29,335,000). The refinery is well advanced in its construction, and the first stage will be ready to start operations by the end of this year at a capacity of 5000 bbl per day. Designs are now underway to complete the refinery and to increase its capacity to 20,000 bbl per day. The completed refinery will have the most modern equipment for crude distillation, thermal reforming, polymerization and other facilities for the production of high grade petroleum products, including gasoline, kerosine, fuel oil, lubricants, wax, and asphalt.

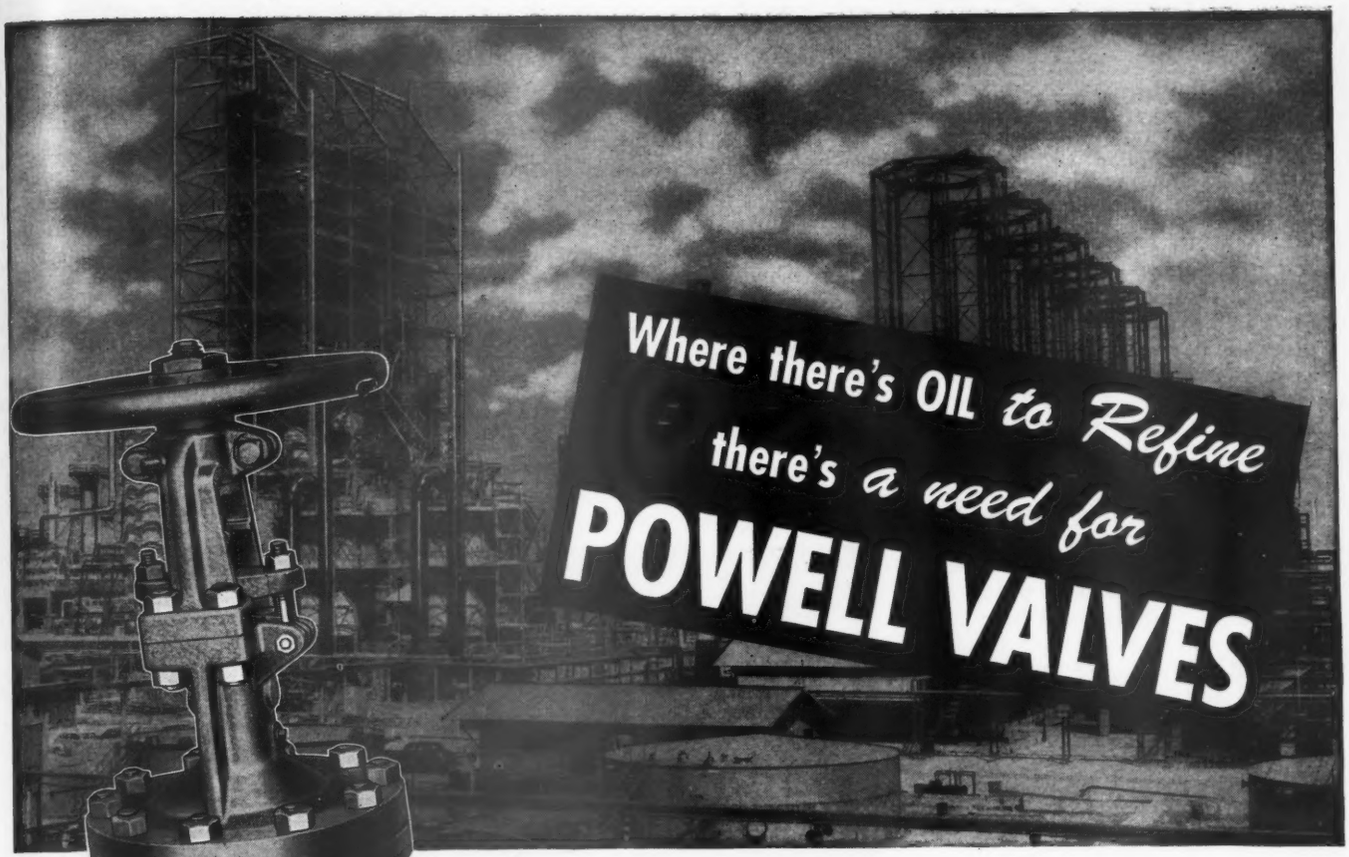
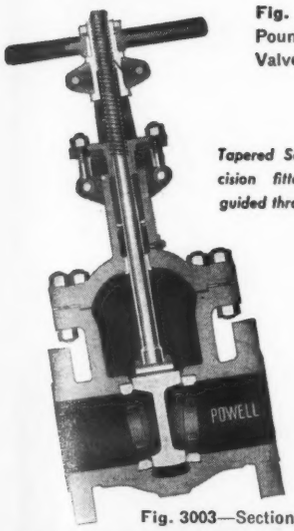


Fig. 3003—Class 300 Pound Cast Steel Gate Valve.



Tapered Solid Wedge is precision fitted and accurately guided throughout entire travel.

Fig. 3003—Sectional.

Yes—wherever crude is being refined, there *is* a definite need for Powell Cast Steel Valves*

These valves—stock and special designs, made in all required sizes and in Classes from 150 to 2500-pounds, inclusive—conform to A.S.A. and A.P.I. Standards. They can be furnished with anti-friction bearing yoke for easier hand operation, or with gears, electric or air motor operators.

In addition to Standard Cast Steel and Special Cast Steel Valves, the Powell Line includes all types of Bronze and Iron Valves, as well as Corrosion-Resistant Valves that are available in the largest selection of metals and alloys ever offered to Industry.

So, no matter what your flow control requirements may be—whether for handling high pressures, high temperatures, water, oil, gas, low pressure steam or for corrosion service—there are Powell Valves to meet them. When sending for details mention the kind of valves in which you are interested.

The Wm. Powell Co.

Dependable Valves Since 1846

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* Valves can be made of various alloy steels, including corrosion-resisting and heat-resisting alloy steels. They are designed and built to handle the constantly increasing temperatures and pressures as well as the highly corrosive and erosive fluids encountered in the chemical and process industries—to handle hydrogen chloride in isomerization and diisopropyl plants; hydrofluoric acid, sulphuric acid and sodium hydroxide in alkylation plants; for liquid and solid catalytic cracking; hydrogenation, dehydrogenation, hydroforming, polymerization, the regeneration of catalysts; for controlling flue gases and hydro carbons in transfer lines, and for the hanling of sour crudes.

POWELL VALVES

NEWS

New Shell Plant To Make Waxes

A new wax plant completed recently by Shell Oil Company at Houston, Texas, will produce annually 75,000,000 lb of various types of paraffin wax products, J. G. Jordan, Shell vice president of marketing, announces. The crude wax processed will be obtained in the adjoining refinery as a byproduct of the manufacture of lubricating oils. The products will include waxes for milk cartons, candles, bread wrappers, cosmetics and a great number of other commercial and industrial items, Jordan states.

Waxes for food packaging purposes have rigid specifications, which require that no materials can have contaminants, and must not change color. Five grades of finished wax will be produced, and will be shipped in 10-lb cakes or in liquid form in insulated tank cars.

Instrument Course Vacancies

The Fischer and Porter Company announces a number of vacancies for its next instrumentation course to be held at the Hatboro, Pennsylvania, plant, October 10 through 14, 1949.

The course will cover manufacture, calibration, installation, operation and maintenance of the company's complete line of "Flowrator" primary and secondary process control instruments. (Some time is also devoted to the basic principles of variable-area flow measurement.) It is designed for engineers responsible for process control instrumentation and for instrument specifications, installation, operation, and maintenance.

Italian Refinery Shareholders Meet

Shareholders of Stanic, a new Italian oil refining company jointly owned and operated by Standard Oil Company (New Jersey) and the Italian-owned company of Anic, have determined at their first meeting to increase the company's capital and to modernize its refineries at Leghorn and Bari, Italy.

The shareholders' meeting in Milan voted to increase the initial capital of Stanic from 20 million Lira ($35,000) to 12 billion Lira ($21,000,000).

Immediately preceding the shareholders' meeting, the board of directors of Stanic held their first session under the presidency of Dr. Ernesto Santoro. Nominated as managing directors were Victor J. Decorte by the American group and Dr. Santoro by the Italian group.

Huge Vessel Floated To Carthage Plant

Recently two huge vessels built by Wyatt Metal and Boiler Works for the snythetic hydrocarbons plant of Carthage Hydrocol, Inc., near Brownsville, Texas, too large to travel via rail or cargo ship, were made watertight and floated down the Houston Ship Channel and the Gulf of Mexico to the plant where they are installed. These vessels were made of carbon molyodenum steel, ASTM A-204, are 17-ft o.d. and 57-ft, 8-in. long, a wall thickness of 3-in., and weigh 284,000 lb each.

It was necessary to employ a special "low-boy" carriage to transport the vessels, shipped at different times, to the ship channel, and a special crane to lower each into the water. Before shipping, the vessels became their own stress-relieving furnace, a 3-in. asbestos covering being placed around them, and hot gases from a furnace were blown into them to attain the more than 1200 F stress-relieving temperature, which was held for the required length of time. Houston authorities required the shippers to transport the vessels through the streets to the channel "after midnight," to avoid traffic congestion. The accompanying photos show the first vessel shipped and the methods employed.

Special "low-boy" trailer was built to move vessel to Houston Ship Channel.

It arrives at the channel and is picked up by a super-crane.

Vessel is dropped into water to float to gulf.

Gasoline Plant for Benedum Field

Construction of a natural gasoline plant, to process the casinghead gas produced from the Benedum field in Upton and Reagan Counties, Texas, is progressing rapidly, according to an announcement made by John T. Oxley, president of Texas Natural Gasoline Corporation. It is located on the Dixon lands in the center of the Benedum field, discovered by Slick-Urschel Oil Company who started initial production in December, 1947.

The plant is being constructed jointly by Texas Natural and Slick-Urschel. Texas Natural is designing, processing, and engineering the plant. The plant does not include a steam generating plant and has eliminated the conventional type of de-ethanizer. This design was pioneered originally by members of the engineering staff of Texas Natural Gasoline Corporation. Texas Natural will also be the operator of the plant and will market the products therefrom, natural gasoline, iso-pentane, butane, iso-butane, and propane. J. F. Pritchard and Company, of Kansas City, Missouri, has the contract to construct the plant.

The capacity of the plant will be 55,000,000 cu ft of gas daily and will necessitate the installation of in excess of 3000 compressor horsepower and 1000 kw generator unit. A treating plant is also being constructed to remove the hydrogen sulphide from the gas and the residue gas will be sold to El Paso Natural Gas Company, El Paso, Texas. Completion of the plant is scheduled for the fall of 1949.

Speed Mercury Cleaning

Oil refineries using mercury refining processes may now clean the mercury for re-use by a new method just developed by the Bethlehem Apparatus Company, of Hellertown, Pa.

Dissolved metals are removed through an oxidation process by the new apparatus, known as the Bethlehem Mercury Oxifier. Any oils, dusts and greases are then removed by filtering through the Type F "gold adhesion" filter. Depending on the type of contamination, refineries may use the complete process, or either part.

The oxifier is essentially a glass drum into which the mercury is poured and whipped into a thick spray by an agitator run by an electric motor. This cleaning process is founded on the principle that base metals oxidize with the air and reduce to a dry, powdery and non-cohesive metallic oxide.

Cotton Valley Refinery Purchased by Dulien

Appraised in 1947 at the present day reproduction cost of nearly $7,500,000, and at the re-use value of nearly $2,000,000, The Cotton Valley, Louisiana Refinery, designated as Plancor 592, was purchased for liquidation from the government by Dulien Steel Products, Inc. of Seattle, Washington.

The facilities were installed for the special purpose of producing alkylate, a component of 100 octane aviation gasoline used by the Armed Forces in World War II. The major processing facilities comprised a dehydrogenation unit, an HF alkylation unit, and a tetraethyl lead blending plant. The dehydrogenation unit was used to produce butylene that was then alkylated with isobutene in the alkylation unit.

It was planned originally that the plant would blend alkylate with base stock and tetraethyl lead to produce 100 octane aviation gasoline. When the plant was placed in operation on February 29, 1944, it was found advisable to ship the straight alkylate to other refineries for blending and so the blending facilities at Cotton Valley were not operated.

Louis Dulien, president of Dulien Steel Products, Inc., completed negotiations recently for the purchase of the Cotton Valley Refinery and it is being offered for resale as a whole unit or piece by piece. A liquidation office has been established at the plant, which is located about 45 miles from Shreveport.

Refinery Fire-Fighters

An example of the efforts being put forth by the oil industry to reduce fires and injuries in their refineries can be found in the work of the refinery fire marshals, an organization sponsored and guided by The National Petroleum Association.

The Kentucky-West Virgina group of this national organization meets every two or three months and goes over each other's refinery with a "fine comb" inspecting for all possible fire and accident hazards. After finding any fire and accident possibilities, the group reports to the management so they can eliminate them.

The Kentucky-West Virginia group includes representatives from Latonia Refinery at Latonia, Kentucky; Ashland Refinery at Leach, Kentucky; Elk Refinery at Falling Rock, West Virginia; Pure Oil Refinery at Cabin Creek, West Virginia; Quaker State Refinery at St. Marys, West Virginia.

MERCOID

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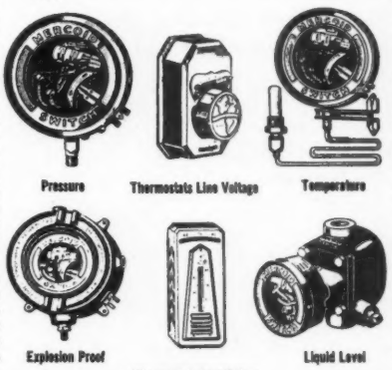
THE ONLY 100% MERCURY SWITCH EQUIPPED CONTROLS

The distinguishing feature of Mercoid Controls is the exclusive use of Mercoid hermetically sealed mercury switches. These switches are not subject to dust, dirt or corrosion, thereby assuring better performance and longer control life.



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Explosion Proof · Thermostats Low Voltage · Liquid Level

Float Operated · Oil Burner Safety · Transformer-Relay

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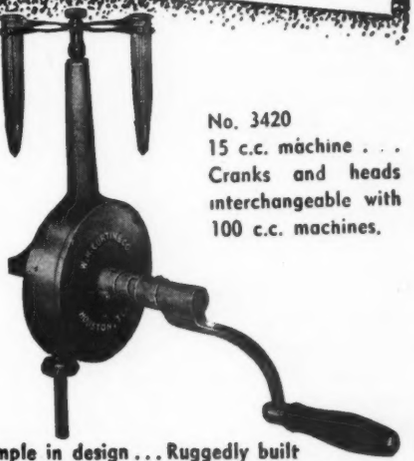
QUICK, ACCURATE RESULTS LESS EFFORT

Curtin CENTRIFUGES



No. 3420
15 c.c. machine . . .
Cranks and heads interchangeable with 100 c.c. machines.

Simple in design . . . Ruggedly built . . . Requires no special care . . . Great Ratio and throw of crank produce required speed with no strain. Curtin Centrifuges meet all *A.S.T.M. Standard Method D-96* and *A.P.I. Code No. 25* requirements. Fully descriptive literature upon request.

W·H·CURTIN & CO.

HOUSTON . . . . NEW ORLEANS.

NATURAL GASOLINE AND ALLIED PRODUCTS UTILIZED AT REFINERIES IN THE UNITED STATES, BY DISTRICTS, 1932-1947

(Thousands of Gallons)

ANNUAL

District	1932	1933	1934	1935	1936	1937	1938	1939
East Coast	26,922	46,578	54,894	60,606	48,888	64,680	50,316	89,880
Appalachian	15,834	9,954	11,928	13,104	12,390	15,204	11,298	12,474
Indiana, Illinois Kentucky, etc	78,078	74,970	98,616	137,382	158,172	171,234	188,496	189,672
Oklahoma, Kansas, Missouri	203,574	208,656	246,708	267,876	267,372	247,590	242,424	214,704
Texas Inland	136,418	142,968	171,318	177,912	185,892	244,272	278,250	259,938
Texas Gulf	134,442	105,504	95,340	110,838	170,352	282,660	254,646	226,842
Louisiana Gulf	35,028	11,928	9,702	12,516	13,524	35,070	16,044	13,860
Arkansas—Louisiana Inland	33,768	17,094	22,596	18,354	23,730	30,702	30,954	22,386
Rock Mountain	41,622	34,398	33,726	36,120	38,640	34,692	33,726	29,862
California*	400,260	412,482	437,976	468,342	501,354	527,898	572,208	603,834
United States	1,105,944	1,064,532	1,182,804	1,303,050	1,420,314	1,654,002	1,678,362	1,663,452
(Thous of bbl)	26,332	25,346	28,162	31,025	33,817	39,381	39,961	39,606

District	1940	1941	1942	1943	1944	1945	1946	1947
East Coast	75,222	83,328	36,582	30,660	87,066	70,854	49,602	37,086
Appalachian	16,128	20,286	21,462	18,060	17,220	18,270	21,210	22,260
Indiana, Illinois, Kentucky, etc	238,770	309,582	318,570	315,000	374,262	348,978	297,360	339,696
Oklahoma, Kansas, Missouri	219,996	197,400	172,032	217,098	203,700	223,020	234,948	252,084
Texas Inland	279,342	326,844	265,104	360,822	347,424	421,806	461,076	500,262
Texas Gulf	266,700	392,658	747,558	795,480	850,122	854,028	656,964	710,850
Louisiana Gulf	11,676	32,718	127,050	171,738	192,738	139,650	106,386	130,200
Arkansas—Louisiana Inland	15,162	33,726	57,918	57,036	74,256	93,996	57,582	39,900
Rock Mountain	30,744	33,138	33,474	27,972	48,258	63,084	42,966	38,556
California*	507,234	578,970	597,240	576,450	627,648	719,922	712,068	898,170
United States	1,660,974	2,008,650	2,376,990	2,570,316	2,822,694	2,953,608	2,640,162	2,969,064
(Thous of bbl)	39,547	47,825	56,595	61,198	67,207	70,324	62,861	70,692

BY MONTHS—1947

District	January	February	March	April	May	June
East Coast	6,216	5,082	3,402	3,528	756	714
Appalachian	2,394	1,848	2,226	1,890	1,722	1,806
Indiana, Illinois, Kentucky, etc	27,678	23,982	24,444	26,376	25,662	28,182
Oklahoma, Kansas, Missouri	25,410	21,798	20,916	17,262	17,514	18,312
Texas Inland	37,968	32,172	41,622	46,536	29,358	49,434
Texas Gulf	55,440	43,386	53,256	52,752	59,976	57,582
Louisiana Gulf	12,600	9,366	9,450	11,718	11,802	9,828
Arkansas—Louisiana Inland	3,864	3,948	3,402	3,276	2,982	3,360
Rocky Mountain	3,948	3,528	3,444	3,528	2,814	2,016
California*	70,560	61,026	59,220	69,090	70,014	76,482
United States	246,078	206,136	221,382	235,956	222,600	247,716
(Thous of bbl)	5,859	4,908	5,271	5,618	5,300	5,898

District	July	August	September	October	November	December
East Coast	3,276	420	1,344	3,948	4,662	3,738
Appalachian	1,764	1,512	1,806	1,638	1,638	2,016
Indiana, Illinois, Kentucky, etc	27,678	31,122	30,156	31,920	32,088	30,408
Oklahoma, Kansas, Missouri	17,010	19,656	23,688	24,738	23,520	22,260
Texas Inland	40,572	47,166	47,544	44,436	42,378	41,076
Texas Gulf	69,300	64,596	64,260	61,404	65,100	63,798
Louisiana Gulf	11,256	12,474	12,306	10,332	10,248	8,820
Arkansas—Louisiana Inland	3,402	3,360	3,108	3,402	2,982	2,814
Rocky Mountain	1,806	2,478	4,368	3,192	3,318	4,116
California*	83,328	89,250	84,966	81,900	79,632	72,702
United States	259,392	272,034	273,546	266,910	265,566	251,748
(Thous of bbl)	6,176	6,477	6,513	6,355	6,323	5,994

*Includes natural gasoline run through pipe lines.

Source: U. S. Bureau of Mines.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

NATURAL GASOLINE AND ALLIED PRODUCTS PRODUCED IN THE UNITED STATES BY STATES AND BY METHODS OF MANUFACTURE, 1944-1945

1944

State	Number of plants operating				Production (Thousands of gallons)			
	Compression*	Absorption††⊛	Cycling △	Total	Compression*	Absorption††⊛	Cycling △	Total
Arkansas	0	12	0	12	0	75,536	0	75,536
California	0	79	0	79	0	771,280	0	771,280
Colorado	0	0	0	0	0	310○	0	310○
Illinois	18	7	0	25	897	193,472	0	194,369
Kansas	2	10	0	12	1,521	68,313	0	69,834
Kentucky	1	3	0	4	859	47,883	0	48,742
Louisiana	3	26	5	34	2,937	137,352	352,370	492,659
Michigan	1	1	0	2	7,658	842	0	8,500
Montana	0	1	0	1	0	4,768	0	4,768
New Mexico	2	7	0	9	2,051	79,110	0	81,161
New York	1	0	0	1	12	0	0	12
Ohio	2	8	0	10	6	7,276	0	7,282
Oklahoma	22	79	0	101	23,454	398,314	0	421,768
Pennsylvania	56	11	0	67	1,635	15,860	0	17,495
Texas	29	113	30	172	149,706	1,050,131	669,658	1,869,495
Utah	0	0	0	0	0	924○	0	924○
West Virginia	51	24	0	75	22,176	66,741	0	88,917
Wyoming	2	4	0	6	700	48,180	0	48,880
U. S. Total	190	385	35	610	213,612	2,966,292	1,022,028	4,201,932
U. S. Total 1943	215	394	33	642	246,237	2,700,625	737,210	3,684,072
1942	234	397	36	667	204,792	2,591,064	703,668	3,499,524
1941	243	403	30	676	255,150	2,649,696	491,064	3,395,910

*Includes 18 plants manufacturing LPG, 1944; 17 for 1943, 16 for 1942, 22 for 1941.

†Includes combination of absorption process with compression and charcoal processes.

‡Includes 163 plants manufacturing LPG, 1944; 167 for 1943, 162 for 1942, 159 for 1941.

⊛Includes 3 charcoal plants in West Virginia with 3,770 M gallons production in 1944; 5 charcoal plants in 1943 with 2,324 M gallons production; 5 in 1942 with 2,940 M gallons; and 6 in 1941 with 4,872 M gallons.

△Includes 21 plants manufacturing LPG, 1944; 20 for 1943; 13 for 1942; 8 for 1941.

○Drip gasoline.

1945

State	Number of plants operating				Production (Thousands of gallons)			
	Compression†	Absorption‡	Cycling ⊛	Total	Compression†	Absorption‡	Cycling ⊛	Total
Arkansas	0	12	0	12	0	85,941	0	85,941
California	2	77	2	81	6,207	779,544	106,002	891,753
Colorado	0	0	0	0	0	351△	0	351
Illinois	16	7	0	23	546	175,446	0	175,992
Kansas	2	12	0	14	1,202	71,435	0	72,637
Kentucky	2	3	0	5	892	45,987	0	46,879
Louisiana	4	26	5	35	10,683	139,288	399,263	549,234
Michigan	0	2	0	2	0	13,630	0	13,630
Montana	0	1	0	1	0	4,726	0	4,726
New Mexico	2	7	0	9	2,718	95,082	0	97,800
New York	1	0	0	1	8	0	0	8
Ohio	2	7	0	9	1	6,451	0	6,452
Oklahoma	18	81	0	99	19,573	396,611	0	416,184
Pennsylvania	47	10	0	57	1,090	13,091	0	14,181
Texas	31	116	31	178	181,356	1,262,487	744,462	2,188,305
Utah	0	0	0	0	0	867△	0	867
West Virginia	52	22	0	74	20,924	66,685	0	87,609
Wyoming	2	4	0	6	957	50,667	0	51,624
Total	181	387	38	606	246,157	3,208,289	1,249,727	4,704,173

†Includes 17 plants manufacturing liquefied petroleum gases.

‡Includes combination of absorption process with compression and charcoal processes. Includes 188 plants manufacturing liquefied petroleum gases; and 3 charcoal plants in West Virginia with 1,461,000 gallons produced in 1945 and 3 charcoal plants with 3,770,000 gallons in 1944.

⊛Includes 26 plants manufacturing liquefied petroleum gases.

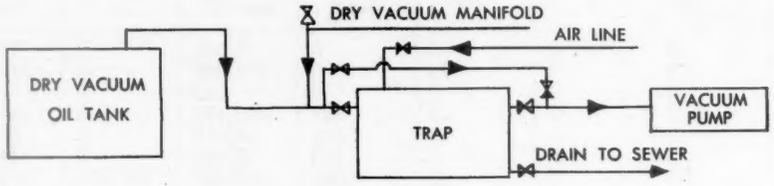
△Drip gasoline.

Source: United States Bureau of Mines.

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

PLANT AIDS

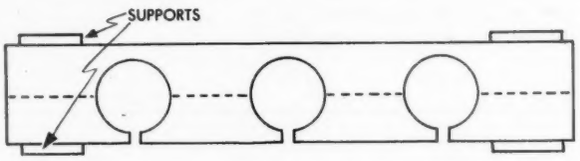
Knockout Drum for Vacuum Lines Effects Savings



A knockout drum, or trap, installed in a vacuum exhaust line where corrosive liquids and/or vapors are handled frequently results in savings and avoidance of shutdowns for parts replacement. Such a trap may be connected into the vacuum line as shown in the drawing. With a bypass as shown the trap may be 'cut out' of the system for draining or repair, without interrupting operations. The air line is provided for blowing out the trap to sewer or other drain line. The installation reduces repair costs and downtime on the vacuum pump, as well as lines.—(Fuller).

Piston Repair Bench

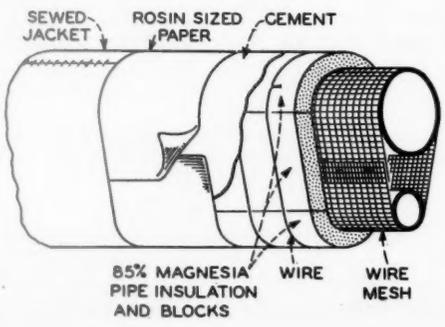
A very satisfactory bench for use in repairing pistons from compressors, engines, and similar equipment is made as illustrated in the accompanying drawing. A timber 2 in. by 12 in. and of any desired length is supported about 4 ft from the floor by suitable legs, after the fashion of a sawhorse, or other suitable manner, so the table will be stable. At convenient intervals 6-in. diam holes are cut in the timber, center of the width, and from the rim of each hole a slot is cut out to and perpendicular to the side of the board; this slot is wide enough to permit passage of the piston rod or other rod or attachment to the item being supported in the bench or rack.—(W. F. Zawatsky).



Insulating Steam-Traced and Steam-Wrapped Lines

Suggestions on insulation of steam-traced or steam-wrapped piping with molded insulation materials such as 85 per cent magnesia or diatomaceous silica are offered by the Magnesia Insulation Manufacturers Association.

In the case of steam-traced piping, a steam line, generally an inch or less in diameter, is run parallel to a process line carrying material which must be kept hot. With steam-wrapped piping, the steam line is wrapped spirally around the process line. In either case the insulation construction should surround both pipes so as to permit the heat to be transferred from the steam to the process line.



With steam-traced lines, half-sections of semi-cylindrical molded pipe insulation, each half of a size appropriate for its respective line, should be fitted around the process line and the steam pipe. At the two sides, blocks of the same thickness as the pipe insulation and cut to fit, should be carefully fitted between the semi-cylindrical sections. The half-sections and the side blocks should be tightly butted together and firmly fastened in place with iron wire. All the joints should be pointed up with asbestos cement, and the entire outer surface covered with a layer of the cement reinforced with hexagonal wire mesh and troweled to a smooth, hard finish.

In some cases, before the insulation is applied, the two lines may be wrapped with wire mesh.

Steam-wrapped piping should be covered with a layer of galvanized expanded metal lath, laced in place with iron wire. The lath serves as a firm foundation for the insulation which should then be applied. Semi-cylindrical or segmental pipe insulation should be used, the size of the insulation depending upon the diameter of the process pipe plus the steam pipe. Insulation application is the same as for any pipe insulation job. The insulation sections are applied, joints butted tightly together, and fixed in place with iron wire.

Depending upon the operating conditions invloved, various finishes such as cement, sewed canvas, asphalt saturated asbestos roofing felt, metal jackets, etc., may be used to cover the insulation.

Low-Temperature Research

An improved type of helium liquefier, designed by R. B. Scott of the National Bureau of Standards, is proving very useful in a program of basic research on the properties of matter at extremely low temperatures, where many remarkable phenomena occur. An important feature of the new liquefier, resulting in greatly increased versatility, is a transfer siphon for delivering the liquid helium to an external receiver that can be easily modified to accommodate the experiment.

The production of temperatures in the reign near absolute zero is becoming increasingly important in many fields of scientific investigation. At the temperature of liquid helium, metals such as lead and tin, ordinarily poor conductors of electricity, become superconductors with a complete loss of electrical resistance. The National Bureau of Standards, with the support of the Office of Naval Research, is now making studies seeking a more complete explanation of this and other low-temperature phenomena. Included in the program is an investigation of the extraordinary properties of helium II near absolute zero, which seems to constitute a fourth state of matter. It is expected that information of much basic scientific interest will result from this work.

Refining Personality

PERSONALS

A. A. Spencer

▸ **A. A. Spencer,** president of Southland Oils, Inc., and general manager of the Southland group, which owns the only two refineries in Mississippi, got his start in the oil business back in 1919. As a young ex-lieutenant just out of the army, he was attracted by the Burkburnett oil boom in Wichita Falls, and soon become affiliated with the Lone Star Refining Company of that city. The Lone Star plant became one of the largest throughput plants in the area, with the outstanding capacity of 5000 bbl per day, quite a large refinery in those days. Spencer was secretary and treasurer as well as sales manager before he left Lone Star.

In 1922 he went into business for himself, organizing the Exchange Petroleum Corporation, which began as a marketing company. This corporation operated a refinery in Albany, Texas, with a general petroleum distribution in West Texas until 1938, when the business closed out.

Spencer joined the Paluxy Refinery at Mankins, Texas in 1939, and transferred with Paluxy's operation to Mississippi in 1941. He has been connected with this organization ever since.

His son Jerry, who finishes the University of Mississippi this summer, studied petroleum engineering at Texas A&M, and it looks safe to predict he will be following in his father's footsteps soon.

Spencer is director, Mississippi State Agricultural and Industrial Board; active in Yazoo County Chamber of Commerce, and Mississippi Petroleum Industries Committee; director for Mississippi, National Association of Manufacturers; and, member of Executive Committee, Mississippi Economic Council.

▸ **J. E. Bogk,** in the refining department of Phillips Petroleum Company for more than 20 years, has been appointed vice chairman of the operating committee, according to an announcement by K. S. Adams, company president.

After training as a civil engineer in his home town of Minneapolis, Minnesota, Bogk spent five years in municipal engineering and contracting in Minnesota and Florida and one year as valuation engineer for Oklahoma Natural Gas Company at Tulsa, Oklahoma. He joined Phillips as chief engineer of the Kansas City, Kansas, refinery in January, 1929.

Prior to his latest appointment, Bogk was manager of the refining department with headquarters in Bartlesville.

▸ **Pendleton Beall,** superintendent of The Texas Company refinery at Casper, Wyoming has retired and will be replaced by **A. E. Higgs,** now superintendent of the company's refinery at San Antonio, Texas. **H. C. Wakefield,** assistant superintendent at Cody, Wyoming of the Casper plant, will be transferred to El Paso, Texas, as head of the company's refinery there, and **E. W. McNealy,** process-engineering department of the company in New York City, will be transferred to Casper as assistant refinery superintendent.

▸ **Frederick Fahnoe,** industrial chemist who has specialized in experimental plant design and acetylene chemical research, has joined the staff of the chemistry department of the Kellex Corporation at that company's Jersey City, New Jersey, laboratory. A graduate of Cornell, Fahnoe has been identified with important exploratory programs in acetylene chemical research. He is a member of the American Institute of Chemical Engineers and of the American Chemical Society.

▸ **Robert V. West, Jr.,** Midland, Texas has been named chief of the recently established petroleum-hydrocarbons department of Slick Urschel Oil Company. He will have charge of the firm's interest in gas-processing plants now being constructed in the Benedum field of Upton County, and in Santa Rosa field of Pecos County, Texas. Prior to joining the company, West was on the technical-service staff of Humble Oil and Refining Company at the Baytown, Texas, refinery.

▸ Appointment of two superintendents for new gasoline plants being built in West Texas by Stanolind Oil and Gas Company have been announced by John R. Evans, manager of North Texas-New Mexico division.

Mitt Dowlen will be superintendent of the Levelland plant, near Levelland, Texas and **C. J. Tighe** will have the same position at the South Fullerton plant, near Andrews. Both appointments are effective immediately. Dowlen and Tighe will direct operations of the plants when they are completed early in 1950.

Dowlen transfers to Levelland from the Hastings gasoline plant, near Alvin, Texas, where he was plant foreman for the past three years. A graduate of Oklahoma A&M College with a degree in electrical engineering, he joined Stanolind in 1941.

Tighe was superintendent of the Stano gasoline plant, near Ulysses, Kansas, which went into operation early this year. With Stanolind since 1948, he has a BS degree in industrial management from Purdue University.

Other changes in personnel include: **Eugene J. Yocom,** superintendent of the Hastings gasoline plant near Alvin, Texas, is transferring to Tulsa, Oklahoma, as an operating engineer in Stanolind's manufacturing department. **John E. Thomas,** formerly superintendent at the La Rosa recycling plant, Woodsboro, Texas, succeeds Yocom at Hastings, and **Stanley A. Wrightman** replaces Thomas at La Rosa. Edward M. Bush, plant engineer at La Rosa, is promoted to plant foreman.

Yocom, a Stanolind employee since 1933, became superintendent of the Hastings plant last December, going there from Stanolind's Jennings, Louisiana, reclycling plant. He has a BS degree in chemical engineering from the University of Illinois and also studied at the University of Kansas and the University of Wyoming.

Thomas was plant foreman at the La Rosa plant before becoming its superintendent. He has served in the latter capacity for nearly four years. Thomas joined a Stanolind predecessor company in 1925.

Wrightman goes to La Rosa from Stanolind's general office in Tulsa, where he was assistant to the chief field construction engineer.

Bush, who went to work for Stanolind in 1943, has been plant engineer at La Rosa for the past five years. He received his BS degree in natural gas engineering from Texas A & I College.

Harold M. Smith

Distinguished Service

In recognition of more than a quarter century of outstanding service in the petroleum research and development work, **Harold M. Smith,** assistant supervising engineer of the U. S. Bureau of Mines Petroleum Experiment Station at Bartlesville, Oklahoma, was awarded the Gold Medal for Distinguished Service by the U. S. Department of the Interior in Washington August 30. Smith has been one of the leaders in research during his 26 years of work in the Bureau, and especially during World War II was one of the directing heads in the critical efforts to develop and provide fuels for the armed forces.

Among his most important efforts was that of the comprehensive survey of available crudes suitable for the production of aviation fuels during the war, when a force at the Bartlesville station made these data available to the authorities. Later Smith became active in directing studies on jet fuels and also on diesel fuels. In the latter work his organization cooperated with the Western Petroleum Refiners Association and with the diesel engine manufacturers in the effort to develop better fuels, to know the composition of diesel fuel fractions and to correlate fuel qualities with engine design and engine performance. As a result of the work done on this subject, the manufacture of 'tailor-made' diesel fuels has been recommended. He is active also in various technical societies including the American Society for Testing Materials, American Chemical Society, and the American Petroleum Institute.

Smith received the A. B. and A. M. degrees in chemistry from Clark College, Worcester, Massachusetts, in 1921 and 1922, respectively. He joined the Bureau as junior chemist in July, 1923, and has been a member of its staff continuously since that date. In addition to his professional work, he is active in civic, educational, and other local, state, and national organizations in the public interest.

Information Forum Feature For Petroleum Engineer Readers

Maintaining its policy of providing for its readers the best in editorial coverage THE PETROLEUM ENGINEER has about completed plans for a technical, economic, and operating Information Forum. It will be a regular monthly feature of the Refining and Gas Processing Edition and will cover every phase of these branches of the industry.

The management has enlisted the services of a large number of outstanding chemists, engineers, industrial economists, petro-chemical leaders, and other authorities to form an Information Panel, to the members of which all questions will be submitted for the best possible solutions of the problems involved. Each member of this panel is a nationally known authority in his field, a specialist; each will have the widest latitude in answering questions submitted by our readers.

Although the information panel principle has been employed elsewhere under various conditions, it is an innovation by this petroleum publication to present authoritative solutions to the problems of refiners and allied technologists on technical, chemical, engineering, and operating subjects. Many of the specialists in this panel have spent years in the industry and have wide experience in the different phases of the refining and gas processing fields. Others of the group are outstanding younger leaders, well informed on the latest developments in applied chemistry, physics, engineering, thermodynamics, and in the utilization of products, their applications to industrial and commercial requirements.

Probably no consulting group ever assembled by the industries involved has as much training, experience, and knowledge as this eminently qualified panel of outstanding scientists and technologists, each ready to answer questions dealing with subjects of vital interest. The feature will begin in an early issue of The Refining and Gas Processing Edition.

Bona fide questions on every phase of refining and gas processing are invited from readers, to be sent to Information Forum Editor, Petroleum Engineer Publishing Company, Box 1589, Dallas 1, Texas.

The personnel of the panel, the fields in which each will cooperate in answering queries on specific problems, and a resume of the position, training, and qualifications of each will be presented in this edition in an early issue.

▸ **Don F. Gerstenberger,** formerly general manager of Inland Empire Refineries of Hillyard, near Spokane, Washington, has been appointed manager for Alcorn Combustion Company for the Southwest and Mid-Continent areas, with headquarters at 410 Thompson Bldg., Tulsa, Oklahoma. Gerstenberger is widely known in the Mid-Continent among refiners and oil men generally, and for many years has been one of the leading refinery manager-technologists of the country.

Gerstenberger returned recently from an extended tour of the Orient, where he was in charge of a party of engineers and economists for the Ralph M. Parsons Company of Los Angeles, in a comprehensive survey of China's oil and refining needs for the ECA. The Alcorn company has headquarters in Philadelphia, Pennsylvania, and is one of the oldest companies supplying heating and other equipment to the refining and natural gasoline industries.

▸ **T. J. Gates** has been advanced to the post of maintenance control engineer at the Torrance, California, refinery of the General Petroleum Corporation. Gates joined General Petroleum in 1946 after four years service in the U. S. Army. A native of Detroit, Michigan, Gates received his degree in chemical engineering from Wayne University in 1942.

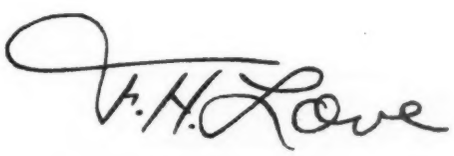
Still Room For Improvement

WORKING conditions in the days of the pioneer pipeliner were more hazardous by far than they are today. Early records show frequencies as high as 45.92 lost time accidents per million man-hours worked. If such a record should occur today it would be viewed with shocked alarm by the industry. Modernization of pipe line equipment and methods, and safety consciousness on the part of management and workers, have reduced both the frequency and severity of accidents manyfold. Despite this advancement in equipment and intensive training, however, there is still room for improvement.

Accident frequency in pipelining has shown an unwelcome rise during the last several years, beginning with 1942 and reaching a peak in 1946. A slight but heartening decline occurred in 1947 and again last year but the rate is higher than it should be. The following figures compiled by the API give the number of accidents per million man-hours worked by years: 1942, 9.46; 1943, 11.37; 1944, 12.91; 1945, 13.61; 1946, 15.51; 1947, 14.66, and 1948, 13.73.

The reasons for this upward trend quite likely have their foundation in the fact that the war took many experienced pipeliners, making it necessary to use a greater proportion of "greener" hands. Also, inferior equipment doubtless was a contributing factor. Nor should it be forgotten that to meet emergencies it was often necessary to construct and repair lines at speeds that invited accidents.

A drop in the frequency rate to 14.66 in 1947 and to 13.73 in 1948 indicates that the pendulum may be swinging back the other way. Nevertheless, the accident frequency rate is still too high and every effort should be made to see that it continues to be reduced. To this end there should be no letup in the amount of safety information disseminated; in some quarters it could be increased. And always, safer ways of pipelining should be sought.



—Photo courtesy of Oklahoma Contracting Co., Inc.

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Oil and Gas Pipe Lines in Mississippi

HENRY N. TOLER

ALTHOUGH it has been only a little over 20 years since the first pipe line was laid in Mississippi, today there are approximately 3000 miles of trunk lines in and crossing the state. Some of these lines are small and serve local areas; others are a part of large transmission systems traversing the state, some as large as 30 in. in size. Several hundred million cubic feet of gas are transported into and across the state daily through these various pipe lines.

There are only three pipe lines that take gas out of Mississippi fields at the present time. These are: Interstate Natural Gas Company, serving the Carthage Point field in Adams County; Southern Natural Gas Company, with a line from Gwinville field in Jefferson Davis County, and United Gas Pipe Line Company, which also takes gas from the Gwinville and Soso fields. Most of the lines transport gas from Louisiana and Texas through the state to their various markets.

At the present time, crude oil pipe lines only transport oil from Mississippi fields. A large line is projected, however, that would carry crude oil from Texas and Louisiana through Mississippi on to the refineries in Ohio. One products line crosses the state, transporting the oil products from Baton Rouge to markets to the northeast.

Generally speaking, pipe line construction in Mississippi is not particularly difficult. It is perhaps easier and less expensive than in many other areas. The land surface ownership in the greater part of the state is held in small tracts. Most landowners are usually easy to deal with in purchasing right-of-way. Surface formations in most places are comparatively soft soil, clay, sand, and loam. There are, of course, a few areas where fairly hard rock is a slight handicap, and there are a limited number of areas where swampy conditions exist.

Other than the Mississippi River, there are few large streams to be crossed.

Gas Pipe Lines

Interstate Natural Gas Company. In 1926, the first gas pipe line constructed in Mississippi was part of the Interstate Natural Gas Company system, which extended from the Monroe field in north Louisiana to the Baton Rouge refinery of the Standard Oil Company. This line crossed the Mississippi River near Natchez and passed through Adams and Wilkinson counties in the southwest corner of the state. This is a 22-in. line and still serves the Baton Rouge refinery with gas from the fields in north Louisiana and the Carthage Point field in Adams County.

Amory Natural Gas Company. The next line to be constructed in Mississippi was a local line approximately 10 miles in length from the Amory gas field in Monroe County, which was discovered in 1926, to the town of Amory. This 10-in. line was completed and put into service in 1927.

In 1930 and 1931, the Mississippi Public Service Company took over the Amory line and also built a 10-in. line from the town of Amory to Tupelo, some 20 miles to the northwest. At about the same time, this company built a line from Amory to the city of Aberdeen to the southwest. Until 1935 gas was delivered to these three towns from the Amory gas field; however, in 1935 the field began to fail and the Mississippi Public Service Company laid a line to West Point to connect with the Southern Natural Gas Company system to supplement the dwindling supply of gas.

In 1942 the Federal Water and Gas Corporation bought out the Mississippi Public Service Company. In 1945 Federal Water and Gas Corporation sold this property to Southern Natural Gas Company, who in turn sold it to the Mississippi Gas Company, one of the subsidiaries of Southern.

In 1948 nine miles of 6-in. line was constructed from the Amory-Tupelo line to serve the town of Okolona, in Chickasaw County.

The Amory field is now depleted and gas is supplied to their line from the system of Southern Natural Gas.

Memphis Natural Gas Company. (Now Texas Gas Transmission Corporation). In 1929, the Memphis Natural Gas Company built an 18-in. line from Monroe, Louisiana, to serve Memphis, Tennessee. This line crosses the Mississippi River near Greenville in Washington County, and continues in a northeasterly direction through northwest Mississippi.

In 1941, the company began to loop this line and at the present time has two parallel 18-in. lines crossing through the state of Mississippi.

On April 1, 1948, the Memphis Natural Gas Company and Kentucky Natural Gas Company merged, forming the Texas Gas Transmission Corporation.

Currently the Texas Gas Transmission Corporation is building a 26-in. line paralleling the two 18-in. lines through Mississippi. This line will run from the Carthage field in east Texas to Ohio. This new system plus the present system, when in full operation, will have a capacity of approximately 600,000,000 cu ft a day.

Southern Natural Gas Company. In 1929, Southern Natural Gas Company completed a 22-in. line from the Monroe field in north Louisiana to the

The Author

Henry N. Toler is a native of Mississippi and attended public schools at French Camp, where he was born. He received his B. S. degree, majoring in geology, at the Louisiana State University, and obtained his Master's degree, majoring in geology, from the University of Illinois in 1929.

Other than a year spent in South America and some time in West Texas, most of his work has been in the Gulf Coastal area.

He has made his home in Jackson since 1931. From 1932 to 1936 he was consultant and did special work for the State Oil and Gas Board. From 1936 to 1938 he was State Oil and Gas Supervisor for Mississippi. Since 1938 he has been with the Southern Natural Gas Company, and for the past several years has been manager of the Geological and Land Departments.

He is at the present time secretary-treasurer of the American Association of Petroleum Geologists.

east across Mississippi, Alabama, and to beyond Atlanta, Georgia. Southern's main line crosses the Mississippi River, in Issaquena County, and continues in an easterly direction across central Mississippi. A 6-in. lateral line was laid from the main line to serve the city of Vicksburg. Taking off at the Benton junction in Yazoo County, an 18-in. line was constructed to Jackson and continued as a 16-in. line in a southeasterly direction to the Mississippi-Alabama line where it was reduced to a 14-in. line to the city of Mobile, Alabama, and a 12-in. line terminating at Pensacola, Florida. Another lateral, 10 in. in diam was laid from the Benton - Mobile - Pensacola line, taking off in Covington County, Mississippi, in a southwesterly direction and terminating at Bogalusa, Louisiana. Another lateral of some length was built from Louisville, Mississippi, in Winston County, to serve the city of Meridian, in Lauderdale County. Short laterals were built to serve other communities in the state.

The latter part of 1930, Southern Natural sold to United Gas its branch line from the Benton junction in Yazoo County to Mobile-Pensacola. United took over the operation of this line in January, 1931.

In early 1930, the Jackson, Mississippi, gas field was discovered and United acquired producing properties and gas purchase contracts from various operators in the field. The Mobile-Pensacola line was served by the Jackson gas field.

In early 1940 approximately 8 miles of 6-in. line was laid by Southern from the main line in Yazoo County to Tinsley, which was Mississippi's first commercial oil field. This line provided drilling gas for Tinsley, which has developed into one of the major oil fields of the country. Gas is still being delivered to the field for pumping and treating the oil, and occasionally for drilling a well.

In 1940, Southern began looping its 22-in. line, which included some loops in Mississippi. In subsequent years additional loops have been made until practically all the main line through the state consists of parallel lines varying in diameter from 18 to 24 in.

During the latter part of 1946 and early 1947, Southern built 80 miles of high pressure 16-in. line from the Gwinville field, in Jefferson Davis County, to connect with its main line system at Pickens. This line was constructed to operate at a pressure of approximately 1000 psi. In 1948 a compressor station was constructed on this line at Rankin. In February, 1947, Southern began taking gas through this line into the main system.

In 1947, Southern constructed approximately 40 miles of 8-in. line from the Gwinville field to the Brookhaven oil field in Lincoln County. This line has a capacity of approximately 20,000,000 cu ft a day and was built to supply gas for the purpose of repressuring the Brookhaven oil field. When the oil is recovered from the field the gas that is being injected will be available for delivery back to the pipe line and distribution to the markets.

By a series of loops and additional lines and compressor stations, the system has been increased from its original capacity of approximately 100,000,000 cu ft a day to more than 400,000,000 cu ft a day at the present time.

An item of some interest perhaps is the Mississippi River crossing. Originally six 10-in. lines were laid across the river and at this time all six have disappeared. Altogether 12 lines crossing the river have been washed away. At the present time there are seven 10-in. lines crossing the river, one 8-in. line, and construction work has begun on an additional five 10-in. lines. These lines are weighted down and laid on the bottom.

Mississippi Industrial Gas Company. In 1930, this company constructed 83 miles of 6-in. line from the Jackson gas field to McComb and Magnolia, near the Louisiana line. The purpose of this line was to serve various towns between Jackson and McComb. United Gas purchased this system in 1932.

United Gas Pipe Line Company. During the latter part of 1930, United Gas purchased the Benton-Jackson-Mobile-Pensacola lateral from Southern Natural Gas Company. In January, 1931, United began delivering gas from the Jackson field through this line.

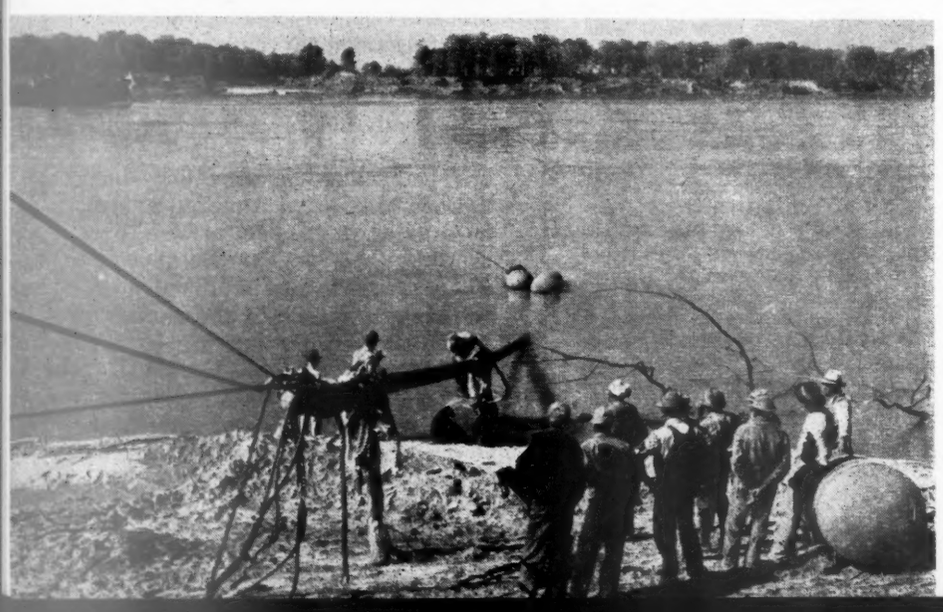
In 1932, United purchased the 6-in. McComb line from the Mississippi Industrial Gas Company and continued to deliver gas from the Jackson field to various cities and towns along this line.

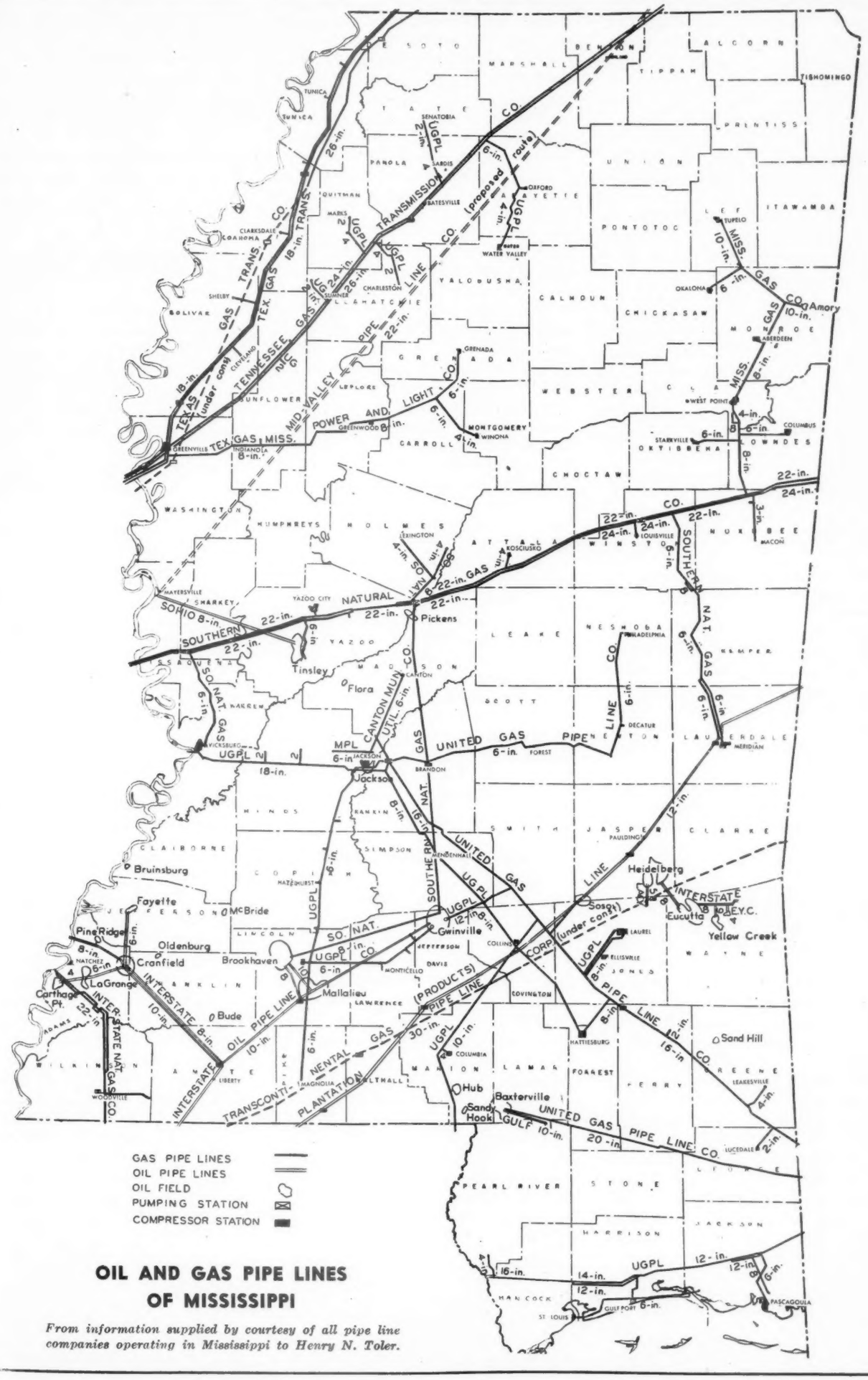
Until 1939 the lines purchased by United obtained gas from the Jackson field and were not connected with United's system to the west in Louisiana. At this time, however, the Jackson gas field began to decline and United built an 18-in. line from Sterlington in the Monroe field to connect with its 16-in. Mobile line at the city of Jackson. This line brought gas from north Louisiana to supplement the supply being obtained from the Jackson field. This line crosses the Mississippi River at Vicksburg and it is perhaps of interest that the procedure followed was to suspend two 14-in. lines on brackets on the side of the Vicksburg bridge. An agreement was entered into with the Vicksburg Bridge Company for this arrangement and it is understood that an annual rental is paid by the pipe line company for the use of the bridge.

During the latter part of 1941, United built a line from Lirette in south Louisiana across Lake Pontchartrain through south Mississippi to connect with the Mobile line near the city of Mobile. This line varies in diameter from 12 to 16 in. and brings gas from the south Louisiana area into the Mobile line. This line across Lake Pontchartrain, for a distance of approximately 25 miles, is 14 in. OD heavy wall pipe, and at the time laid was the longest submarine natural gas pipe line in the world.

In 1943, United purchased from the Wilmut Gas and Oil Company 90 miles of 8-in. line extending from the Jackson gas field to Hattiesburg. This line was originally laid by the Public Service Corporation of Mississippi in 1932 and in 1934 was acquired by Wilmut

Pulling pipe across the Mississippi River. —*Courtesy Standard Oil Company (N. J.)*





OIL AND GAS PIPE LINES OF MISSISSIPPI

From information supplied by courtesy of all pipe line companies operating in Mississippi to Henry N. Toler.

Gas and Oil Company. The line was constructed to serve Hattiesburg and intervening towns with gas from the Jackson field.

In 1946, United constructed 14 miles of 12-in. line from the Gwinville field to connect with its Hattiesburg line and Mobile 16-in. line. In December, 1946, United began taking gas from the Gwinville field for delivery into its system.

In 1947, United laid 86 miles of 6-in. line from Jackson east to Newton and north to Philadelphia. This line serves various towns through this area.

In October, 1947, United completed 34 more miles of 6-in. line from the Gwinville gas field to tie into its 6-in. McComb line at Brookhaven.

In 1948, United constructed 14 miles of 12-in. line to connect the Soso gas field, in the southwest corner of Jasper County, to its Mobile line.

In 1949, United entered into an agreement with the Tennessee Gas Transmission Company to purchase gas from its line for delivery to several towns in northwest Mississippi. United built lines varying in size from 2 to 6 in. to serve 15 towns from the Tennessee line.

At the present time United is building 90½ miles of 20-in. line running from the Baxterville field in southwest Lamar County and southeast Marion County to Mobile, Alabama. When completed, this line will deliver gas from the Baxterville field to Mobile and the Mobile line.

In 1949, United removed that part of the Mobile 18-in. line that extends from the Southern Natural Gas line at Benton for a distance of approximately 32 miles to Jackson.

Municipality of Canton. The municipality of Canton, which is the county seat of Madison County, in 1935 built a 6-in. line for 21 miles from the Jackson gas field to serve gas to Canton. This was a PAW project, with some of the money being donated by PAW and the remainder of the cost of the project being financed by a PAW loan. Since the Jackson gas field is essentially depleted, the city of Canton is purchasing gas from United Gas' line at Jackson to supplement its supply.

Tennessee Gas Transmission Company. In 1944, Tennessee Gas Transmission Company built a 24-in. line from south Texas to West Virginia and Ohio. This line crosses the Mississippi River at Greenville, Mississippi, continuing in a northeasterly direction across the northwest part of Mississippi.

In 1947, a 26-in. loop line paralleling the 24-in. line was built all the way across Mississippi. The Tennessee line crosses the Mississippi River bridge at Greenville somewhat in the same manner as the United Gas line crosses the Vicksburg bridge. It is understood that this company will construct a 30-in. line paralleling its present system and that work has already begun on the project. It is reported that when Tennessee completes its parallel 30-in. line, the entire system will have a capacity of approximately 1,000,000,000 cu ft of gas a day.

Mississippi Power and Light Company. In 1948, Mississippi Power and Light Company constructed 19 miles of 8-in., 26½ miles of 6-in. and four miles of 4-in. pipe line to serve the towns of Grenada in Grenada County, and Winona in Montgomery County. This line connects with the Texas Gas Transmission Company's Greenwood lateral at Indianola and continues in an easterly direction to Grenada and Winona. Mississippi Power and Light Company also distributes gas to various other towns and cities in Mississippi. The gas is purchased at the city gates from pipe line companies.

Transcontinental Gas Pipe Line Corporation. Under construction currently is a 30-in. pipe line by this company extending from south Texas to New York City. This line enters Mississippi in Amite County in the southwest part of the state and passes through the state in a northeasterly direction. A part of this line will be completed during the latter part of 1950. It is estimated that this line will cost approximately $190,000,000 and will have a capacity of approximately 340,000,000 cu ft a day.

Oil and Products Lines

Plantation Pipe Line Company. The first pipe line to be constructed other than for gas was in 1941 when the Plantation Pipe Line Company laid a 12-in. products line from the Baton Rouge refinery to Breman, Georgia, continuing with a 10-in. line from Breman to Greensboro, North Carolina. This line enters Mississippi in Pike County, traversing the southeast corner of the state in a northeasterly direction. It has a capacity of approximately 90,000 bbl a day and is handling primarily gasoline. Terminals along this line serve to distribute gasoline and other products by rail and truck to various points in Mississippi.

Interstate Oil Pipe Line Company. In 1945, the Interstate Oil Pipe Line Company laid a 12-in. line to connect various oil fields in Mississippi to the Standard Oil refinery at Baton Rouge. One branch of the line originates at Gwinville in Jefferson Davis County and runs to the southwest through the Mallalieu field to a point in Amite County where it joins the 10-in. and 8-in. lines that extend to the northwest to the Cranfield, Fayette, Carthage Point, LaGrange, and Lake St. John fields. There is also an 8-in. line from the Brookhaven field to the company's 10-in. line in the Mallalieu field. These two lines connect in Amite County to a 12-in. line, which continues to the Baton Rouge refinery. This system has delivered up to approximately 80,000 bbl a day to the refinery. Interstate also has gathering lines in the Heidelberg field in Jasper County and the Eucutta and Yellow Creek fields in Wayne County. These lines are connected with loading racks along the GM&O Railroad.

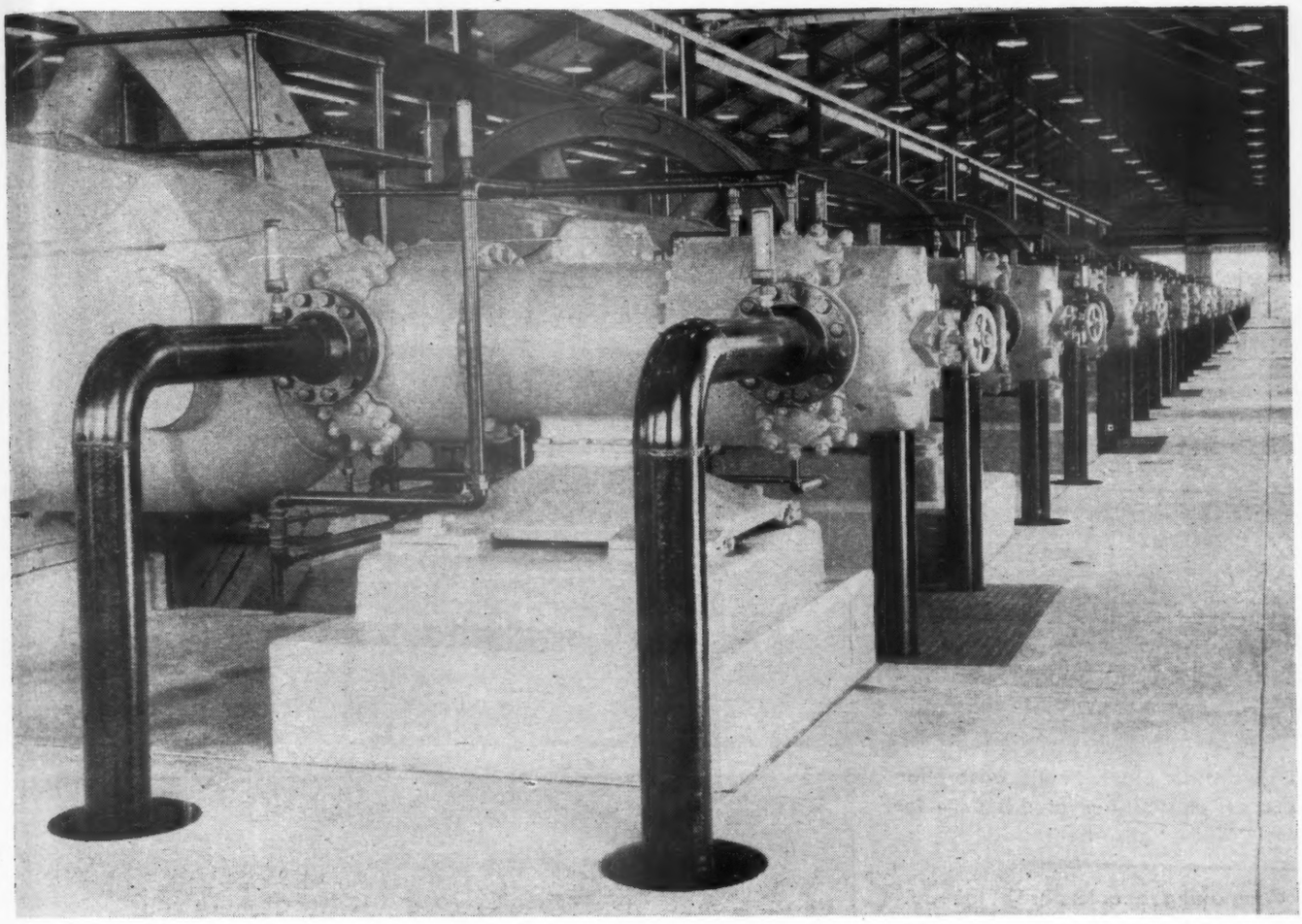
Sohio Southern Pipe Lines, Inc. In 1946 Sohio built an 8-in. line from the Tinsley field in Yazoo County in a westerly direction to a terminal on the Mississippi River at Mayersville, in Issaquena County, where oil is loaded on barges and shipped up the Mississippi and Ohio Rivers to refineries. This line delivers approximately 15,000 bbl of oil per day.

Gulf Refining Company. The Gulf Refining Company constructed 12 miles of 14-in. line from the Baxterville field in Lamar County to a loading rack on the Southern Railroad just north of the town of Lumberton. This line constitutes the principal outlet for the heavy crude oil from the Baxterville field.

Gulf has also built a gathering line in the Soso gas field to handle distillate and laid approximately four miles of four inch line to a loading rack on the G&SI Railroad at the little town of Gitano.

Mid-Valley Pipeline Company. Sun and Sohio have jointly formed the Mid-Valley Pipeline Company for the purpose of laying a 20 and 22-in. oil line from East Texas through North Louisiana across Mississippi and on to Ohio. This line is projected to cross the Mississippi River at Mayersville in Issaquena County where it will pick up oil from the Tinsley field, which is now being delivered by Sohio Southern Pipe Lines, Inc. It will continue in a northeast direction across the northwest portion of the state, leaving the state in the northeast corner of Benton County on the Tennessee line. Right-of-way is being purchased at this time and construction on the line will begin within the near future. This line will cost appproximately $56,000,000 and will have a capacity of approximately 140,000 bbl of oil a day.

Accompanying this article is a map of the State of Mississippi showing all pipe lines within the state. ★ ★ ★



Main compressors are eleven 1600-hp units with two additional units being added at the present time.

P 620.

Modern Stations

Compressor Station Pumps 182 Miles

FRANK H. LOVE*

THE newest compressor station on Cities Service Gas Company's system is in the North Hugoton field, Kansas, approximately 14 miles east of Ulysses. Known as the Hugoton station, this plant is the initial and only station on a 26-in. line that was completed last Fall as far as Newton, Kansas, 182 miles, and this year is being extended to connect with an Ottawa-Kansas City line, also finished last year, which will give a continuous carrier into Kansas City.

The Hugoton station contains eleven 1600-hp twin-tandem compressor units, a total of 17,600 hp, and at this time two more units of the same size are being added. Overall planning calls for 19 units, or 30,400 hp.

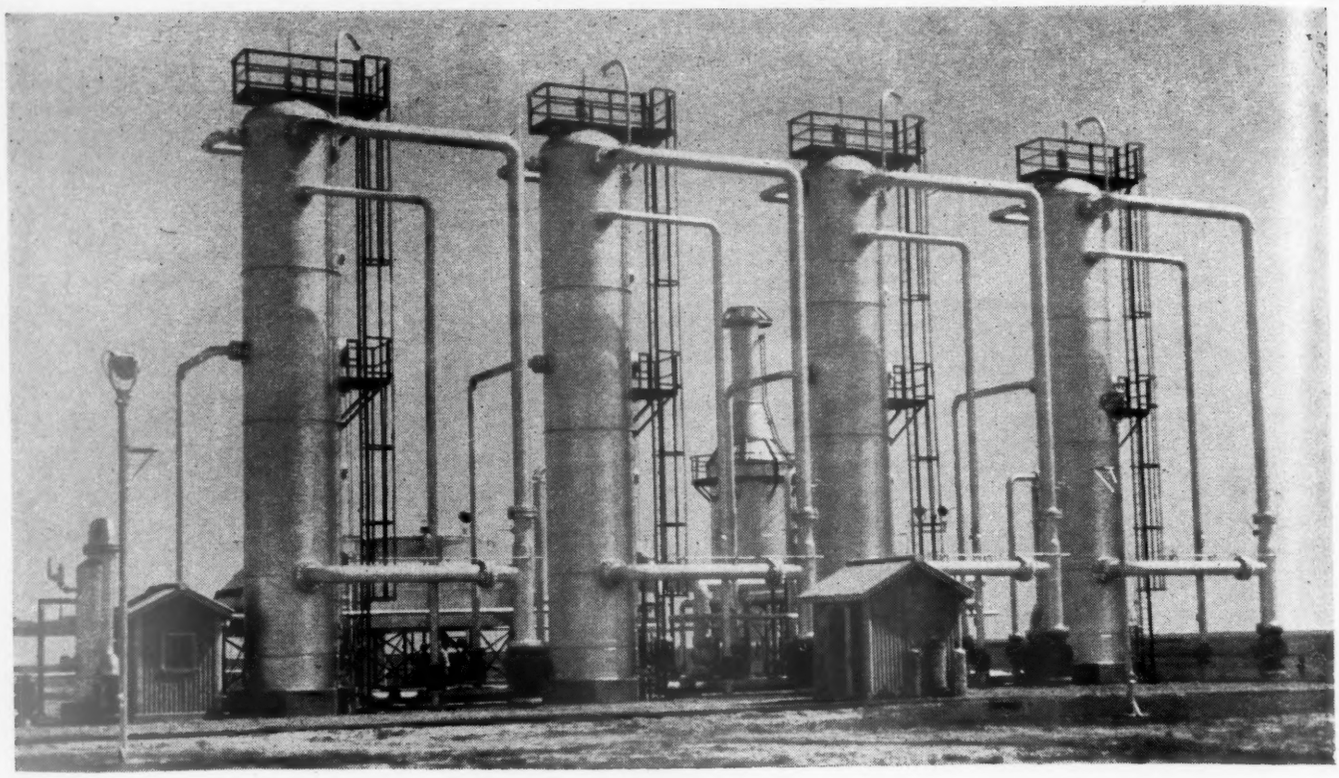
The engines are equipped with a dry type rectifier ignition system, which operate from the plant auxiliary generating units, and a centrifugal type oil purifier is installed in the oiling system. Cooling water to the engine jackets is circulated by vertical turbine pumps driven by 125-hp motors. Starting air is provided by two 9-in. stroke, 300-rpm compressors that discharge at a pressure of 350 psi. The compressors are driven by 50-hp, 220/440-volt, 60-cycle motors.

The station is designed to operate at an intake pressure of 290 psig and discharge of 900 psig. Design capacity is for 300,000,000 cu ft a day.

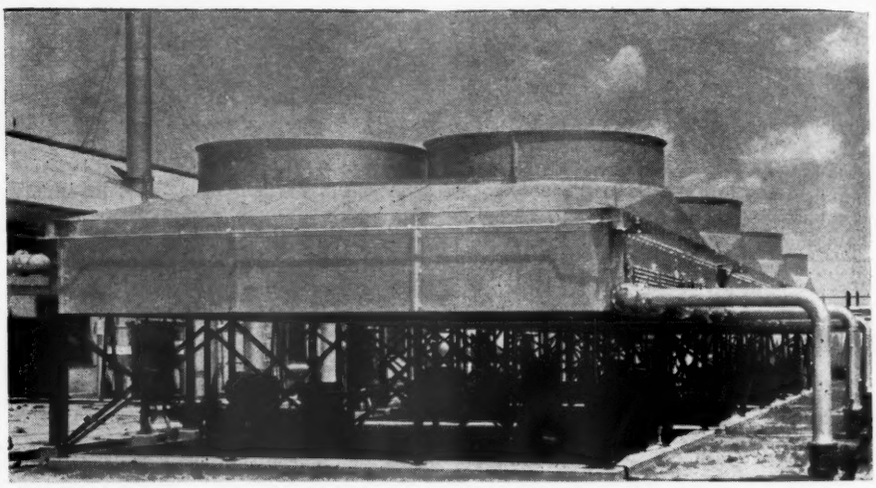
The compressor station is taking gas from about 400 producing wells in an area that contains approximately 375,000 acres. Gas is picked up at the field working pressure of 290 psig, the same as the station intake pres-

EXCLUSIVE

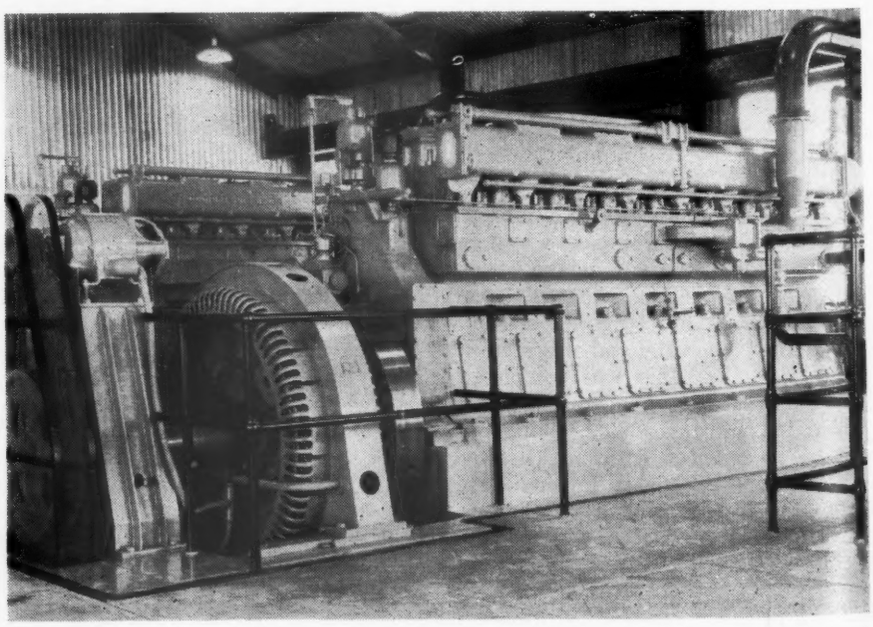
*Transportation editor.



Dehydration plant is solid adsorption process utilizing activated bauxite for adsorbent.



Water and gas coolers are of the radiator type utilizing air for cooling.

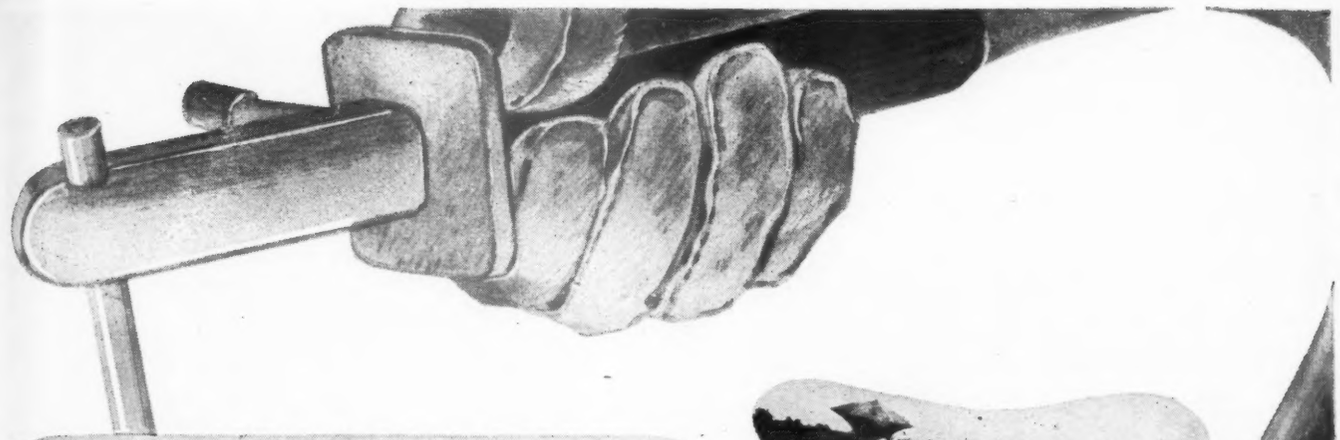


The electrical generating equipment consists of four 600-hp gas engines direct-connected to 400-kw, 480-volt generators.

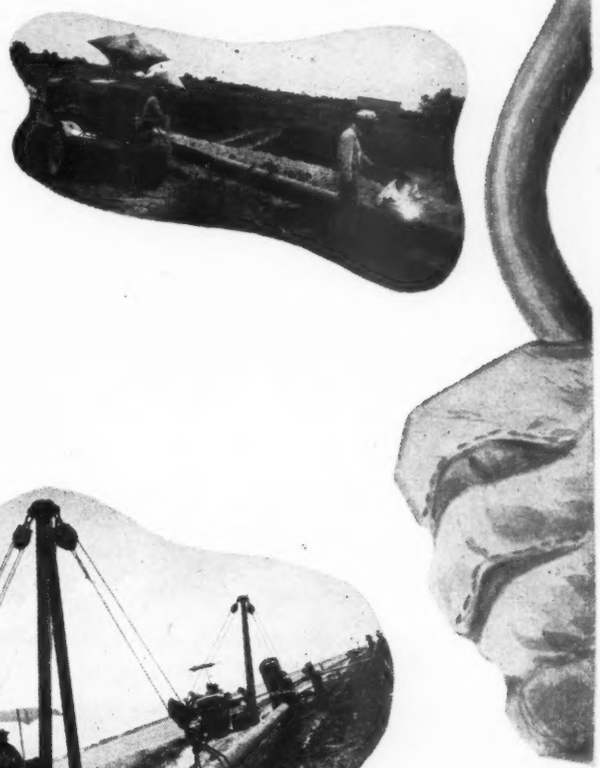
sure, and is first passed through scrubbers, of which there are five having a capacity of 60,000,000 cu ft each, then goes directly to the compressors. During cold weather the intake temperature of the gas is 40 to 42 F and during the summer 60 to 62 F. Discharge temperature varies from 183 to 230 F, but the gas is cooled to 10 to 15 F above atmospheric temperature before being sent to the dehydration system. The gas after-coolers are of the radiator type utilizing air for cooling. Jacket water, incidentally, is cooled by the same type cooling equipment.

Dehydration Plant

The dehydration plant through which the gas passes before entering the transmission line employs the solid adsorption process utilizing activated bauxite for the adsorbent. Four split-flow contacting towers 7 ft in diam by 47 ft high were installed, each tower having a capacity of 150,000,000 cu ft a day. Two of the towers are used



Pipeline Know-how



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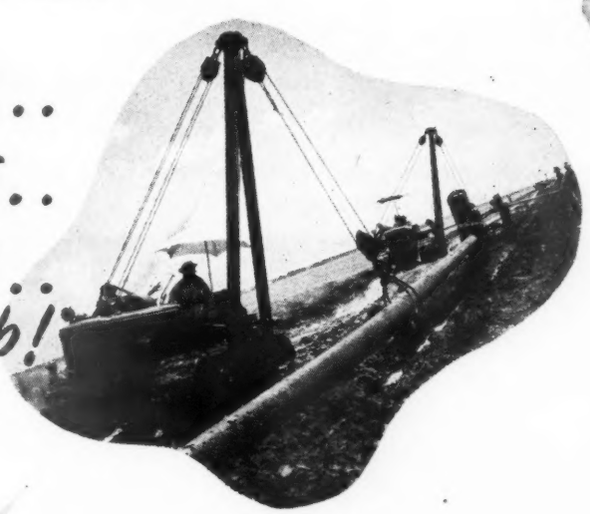

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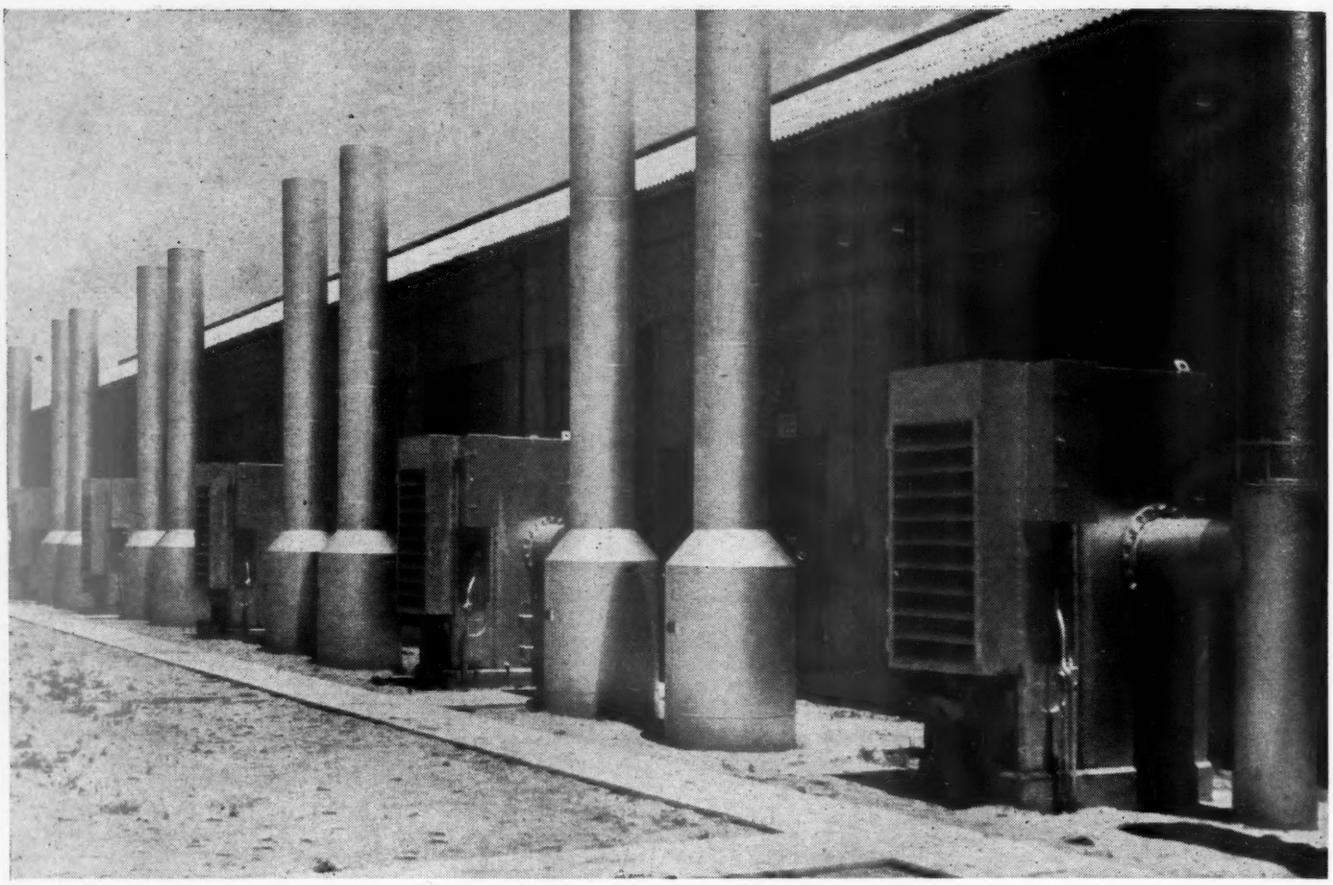
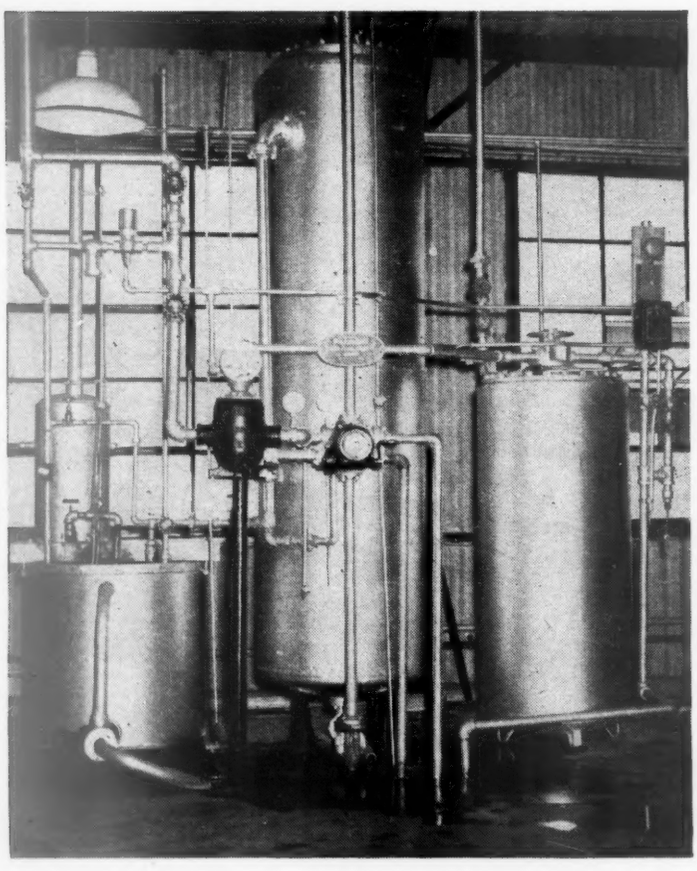


Main compressor mufflers and air filters.

Make-up water for equipment is demineralized in this treating plant.



Water is pumped into this overhead tower from two wells, then distributed to plant and domestic use.

at a time to dehydrate the gas while the other two are being regenerated. The regenerative gas heater is of the Iso-Flow furnace type and the regenerative gas cooler is a radiator type that utilizes air for cooling.

Ordinarily, when the gas enters the dehydrating plant its moisture content is about 45 F above dewpoint. After dehydration the dewpoint is minus 22 F. The plant is designed for 900-psi operation, although at present it is operating at about 700 psi due to the fact that the compressor station is not pumping at full capacity.

Auxiliary Equipment

The electrical generating plant consists of four 13 by 16-in. 400-rpm, 600-hp gas engines direct connected to 400-kw, 480-volt generators.

The main electrical switchboard is of the enclosed cabinet type with draw-out circuit breakers. The main power circuit serving the water coolers is a weatherproof, overhead, bus duct. Other electrical circuits are situated underground.

All jacket water coolers and gas coolers are of the radiator type utilizing air for cooling. There are eight units in water cooling service and three for cooling gas. Each unit has two fans 10 ft 6 in. in diam driven by 30-hp motors.

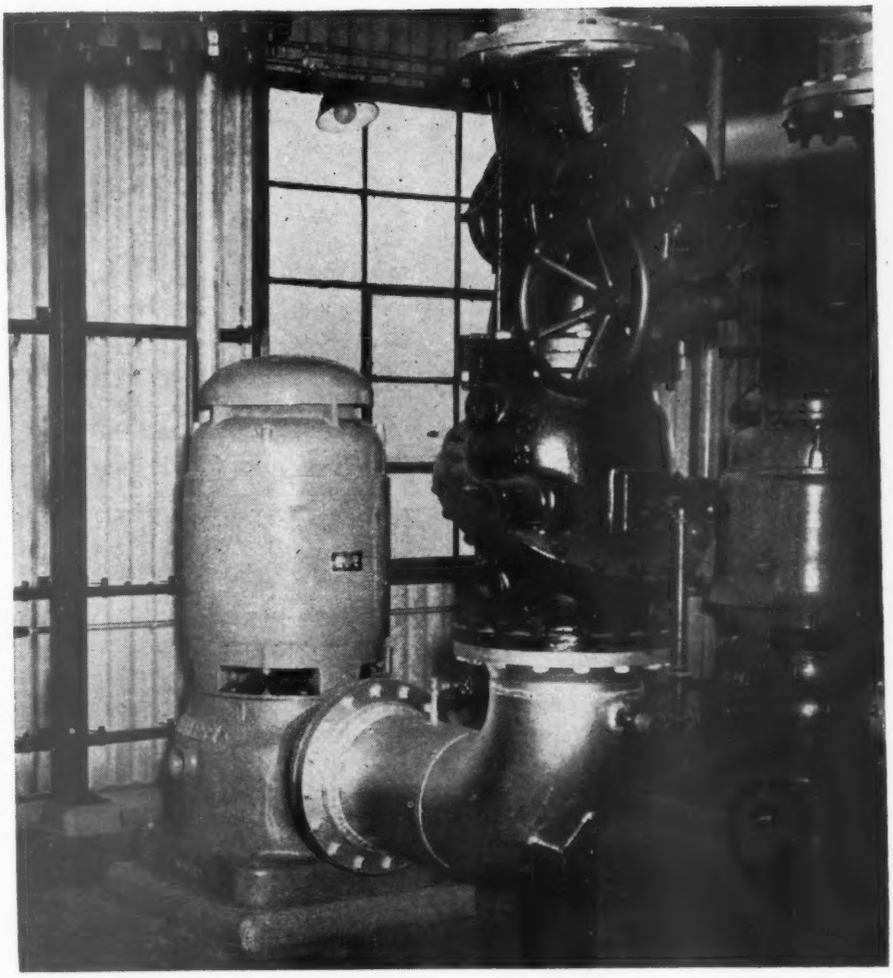
The water supply is obtained from two wells drilled on the station site, both of which are approximately 300 ft deep. Water is pumped from the wells into an overhead tower. For domestic use in the station and camp it is not treated; however, water for engine jacket cooling is treated in a demineralizing plant. Water is discharged from the tower to the treater and then from the treater into the individual cooling systems, each of which is distinct within itself.

All yard piping was designed for an operating pressure of 1000 psi, the ASA code for pressure piping being observed. To eliminate pulsating gas flow from the compressors, pulsation eliminating equipment was installed both on the suction and discharge lines of each compressor.

Because of the flammable nature of the product being handled, the utmost precaution has been taken to avoid fires and equally important steps taken to combat them should they start. Ansul dry chemical fire extinguishers have been placed at strategic points throughout the plant. An accompanying photograph shows one of the wheeled type units.

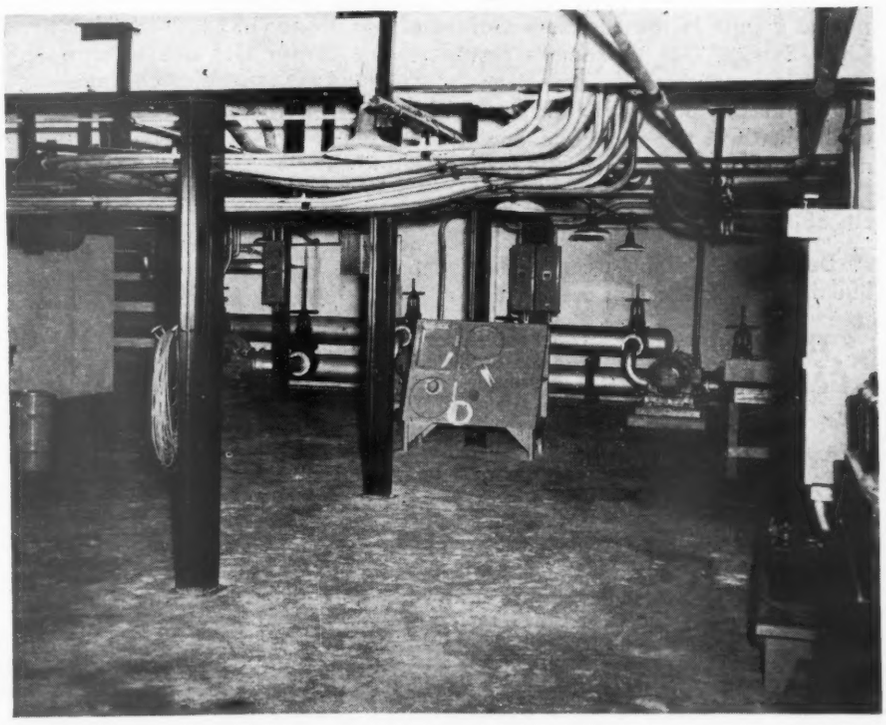
Buildings

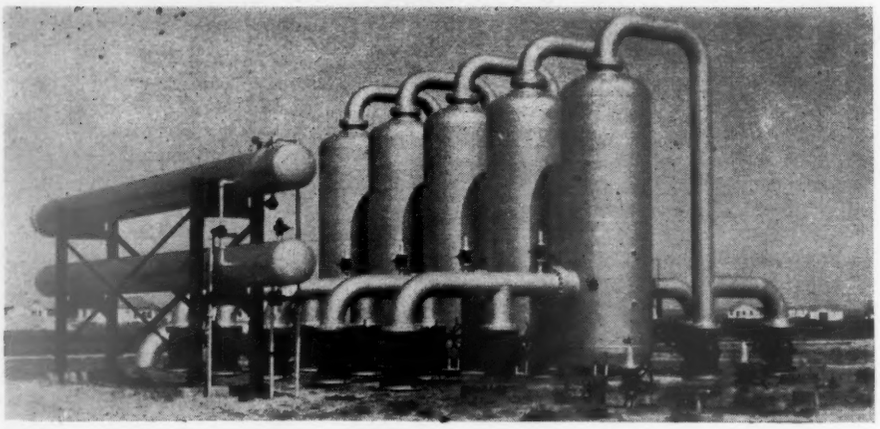
The compressor building is 72 ft wide and 375 ft long. It is of steel-frame construction covered with cor-



Engine jacket water circulating pumps.

Main compressor building and auxiliary building have full basements. This is basement of auxiliary building.





Five gas scrubbers have a capacity of 60,000,000 cu ft a day each.

rugated transite. A 60-ft extension is now being added to take care of the two new compressor units. The auxiliary building, which houses the generating plant, machine shop, heating plant, and store room, is of the same construction. This building is 72 ft wide and 135 ft long. Both buildings have full basements, in which are placed the water piping headers and other service lines. The office building is of wooden construction covered with asbestos shingles.

Long-term planning visualizes a 19-unit station having a total horsepower of 30,400. When this goal is achieved the main compressor building will have an overall length of 665 ft.

These buildings are heated by steam unit heaters. The heating plant consists of a 200-hp marine type boiler equipped with high pressure burners.

Soil Stabilization

Because of the loose, sandy condition of the sub-surface soil it was necessary to do considerable soil stabilization work below engine foundations to prevent future settlement of the foundations and to eliminate vibration. Below the main compressor building the soil was excavated to a depth of 20 ft, approximately 10 ft below the foundation mat. The soil was then gradually replaced, in 3-ft layers, and compacted to a void ratio of less than 0.4 per cent. Each engine block was poured with 333 yards of concrete. The concrete mat required 4500 yards.

Metering

Purchase meters have been installed four miles west of the station and three and a half miles south to measure the gas taken from producing companies. At each purchase meter a calorimeter is provided to determine the Btu of the gas. A check meter is situated six miles east of the plant on the discharge line to measure gas before it enters the transmission system. At the station there is a meter setting for determining station fuel consumption. This is the only meter run at the station proper.

On the plant site, which consists of 320 acres of what once was wheat land, a modern dwelling unit has been built to accommodate the operating personnel. A total of 51 modern houses with full basements have been constructed. Complete utilities services are supplied each dwelling. Streets are hard-surfaced and have curbs and gutter and the grounds are landscaped. A recreation building has been erected, nicely furnished, equipped with a modern kitchen, piano, radio

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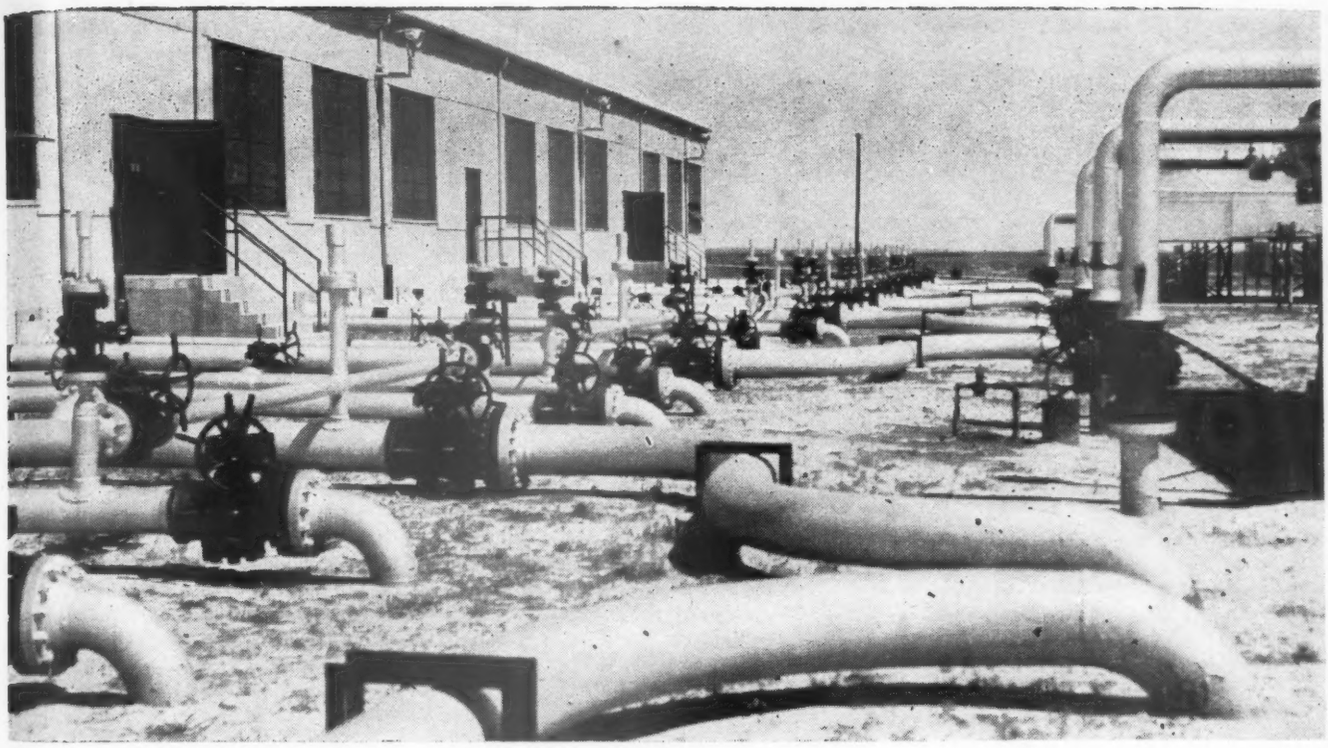
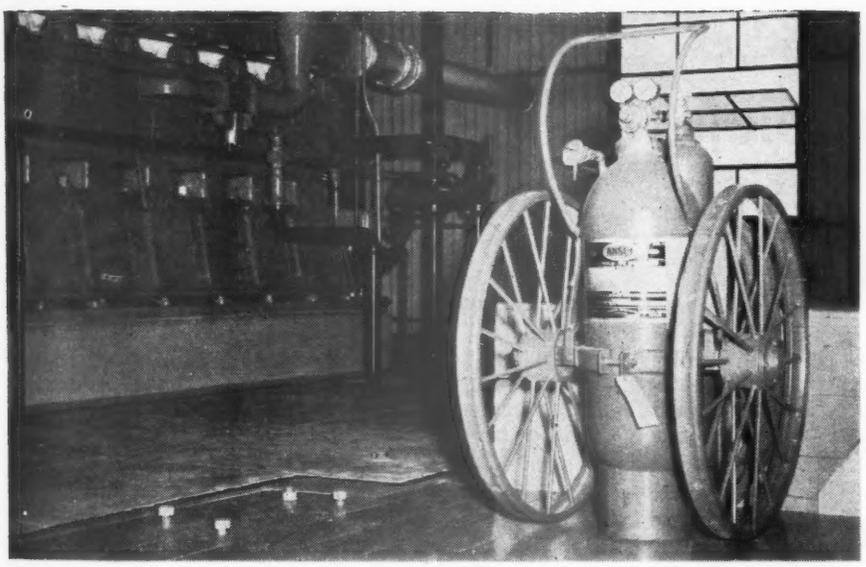
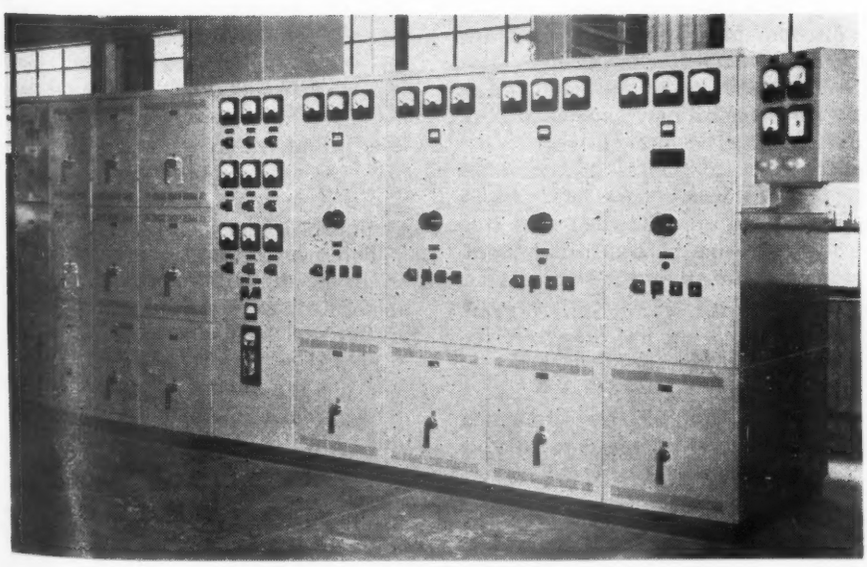




Intake and discharge piping to the main compressors.

Ansul wheeled type dry chemical fire extinguisher.

The main electrical switchboard is of the enclosed cabinet type with draw-out air circuit breakers.



combination, and similar accoutrements for the use of the operating personnel and their families. Also within the 320-acre plant site is an airplane landing strip to accommodate company planes visiting that part of the system.

The operating crew consists of 47 men. Harold Moore is station superintendent and Carol McCoy assistant superintendent.

The Cities Service organization supervised the overall construction of the plant. H. O. Porter was in charge of the initial installation and Carol McCoy is supervising the new construction now under way. Certain contracts were let, however. Harmon Construction Company of Oklahoma City, Oklahoma, did the concrete work; Western Steel Erection Company of Oklahoma City erected the steel and transite buildings although the buildings themselves were manufactured by Capitol Steel and Iron Company of Oklahoma City, and the dehydration plant was installed by J. F. Pritchard and Company of Kansas City, Missouri. ★ ★ ★

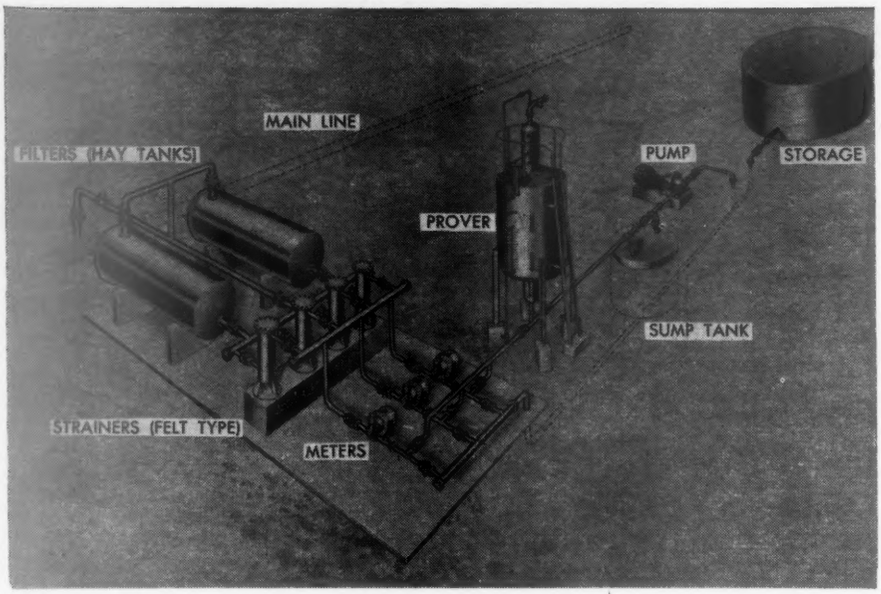


FIG. 1. Schematic drawing of a typical three meter take-off battery.

Metering Crude Oil Presents Special Problems

H. D. LEISENRING*

THE problem of metering pipe lines carrying liquid hydrocarbons resolves itself into two very different parts, namely the metering of crude oil and the metering of finished products.

The first of these, crude oil, has not as yet been successfully metered under all the various conditions, whereas the second, finished products, has been metered successfully in nearly all phases of the overall operation.

The successful metering of crude oil presents many complex problems and, although the various types of meters in use today have been satisfactory under certain conditions, none of them can be classified as an answer to the entire problem. The variables present in crude oil metering are the reason for its complexity and it is believed each application will require special study before metering can be successful. There will be many applications where meters in their present day form cannot be used.

Movements of crude oil in pipe lines vary greatly with respect to their rates of flow and it is not impossible to imagine rates from one or two barrels per day to rates of many thousands of barrels. The former condition, however, occurs in gathering lines and will not be considered part of this discussion.

The general make-up of the oil itself seems to be the foremost problem as it contains materials that are detrimental to good meter performance. Crude oil is a good lubricant and normally should enhance the life and operation of a meter but the corrosive elements, salt water and sand, offset any value the oil may have as a lubricant. Normal meter construction requires close tolerances and also the use of bearings, gears, etc., which wear out too quickly when subjected to the corrosive and abrasive conditions normally present in such service.

When certain conditions prevail, however, crude oil has been metered efficiently and in most of these instances the life of the meter is excellent. Many times reports circulated about such installations tend to give the false impression that crude oil metering is an easy task. The conditions under which this success has been obtained are such that most of the sand, salt water, pipe scale, and other corrosives and abrasives normally present have been removed. The removal has been accomplished either by natural conditions or by artificial means. In crude oil that has been in storage several times or moved long distances before metering, foreign matter tends to settle out of its own accord. The cleaning equipment normally used on finished products generally cannot be used on crude. Filters would plug too fast and if paraffin is present even common strainers are not too successful. Strainers, if used, are usually constructed with large screen openings to prevent any rapid build up and consequently their only purpose is to keep out the very large foreign particles that may be present. Settling tanks probably do the best job of cleaning up the stream.

Some heavy crudes must be handled hot and although this situation is not too serious it is a problem as it then becomes necessary to compensate for temperature changes in the metering system, either by automatic means or by the actual calculation. The variation in API gravity is another factor that must be considered when determining the final answer. This factor can be compensated for in the same manner as for temperature variations. It is also essential that the crude oil be gas free before good metering is possible. Entrained gas tends to make a relatively incompressible liquid volume compressible so that even with a supposedly "gas free" liquid it becomes necessary to apply a compressibility factor.

The proving of meters handling crude oil offers another problem that has already been solved with finished products. Crudes, due to the variables discussed previously, and to one other factor, viscosity, are rather difficult to handle in a volumetric type proving tank. The ideal type prover for this operation is a gravimetric type where actual weight is checked against the meter reading. Weigh tank or gravimetric provers are difficult and ex-

*Rockwell Manufacturing Company.

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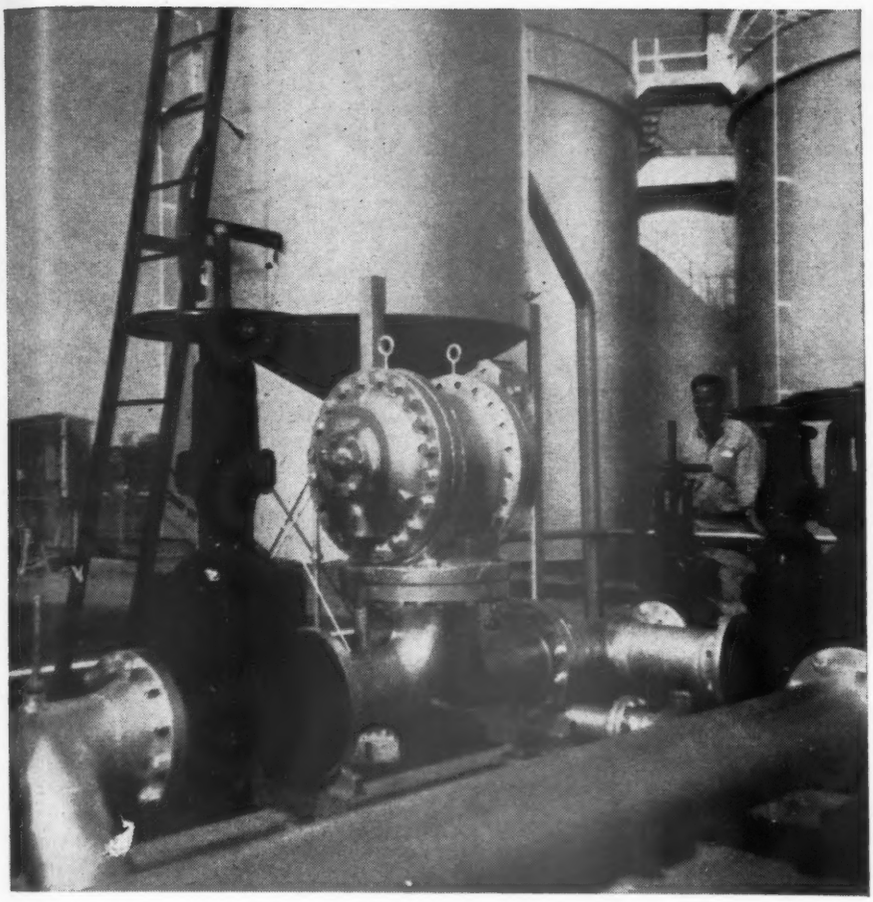

FIG. 2. View of 6-in. meter installed.

pensive to use in the field and therefore have not been generally adopted. Some success has been obtained with volumetric provers but it requires extremely careful operation.

The conclusion, therefore, regarding crude oil metering should be that it can be done when certain ideal conditions prevail but cannot be done when the most unfavorable elements are present. There will be a group of installations where the conditions are between the good and the bad and successful operation will then depend entirely on what is considered a satisfactory meter life.

Finished products, as stated before, are being metered by nearly all pipe lines handling them and the operation can be considered efficient and economical. These meters operate on relatively clean fluid inasmuch as finished products are generally filtered and cleaned prior to being metered. Proving, volumetrically, has also been used extensively and with very accurate results.

The problems of temperature, pressure, gravity, and compressibility have all been studied and the results are available.

Fig. 1 is a schematic drawing of a typical three meter take-off battery including the necessary protective equipment and the volumetric proving equipment. Batteries of meters are recommended for this service so that standby equipment is available for maintenance, proving, shutdowns, etc. The size and number of meters should be calculated to handle the full line capacity, bearing in mind that each meter has a capacity limit. The manifold should be flexible and arranged so that product intermingling is at a minimum.

A crude oil station would involve relatively the same scheme except for a change in the protective equipment and the possibility of a gravimetric or weigh tank prover.

Fig. 2 shows an actual view of a 6-in. meter on one leg of a take-off manifold.

The Petroleum Positive Displacement Meter Code published by the ASME and API jointly, discusses finished product pipe line metering in detail and certainly in the very near future there will be a similar code covering the metering of crude oils.

* * *

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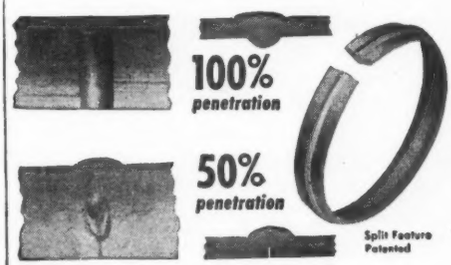

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Design of Trans-Arabian Pipe Line*

S. P. JOHNSON†

Part 3—Conclusion

Pumping Stations

The pumping stations on the Trans-Arabian Pipe Line are of interest mainly because of their large size rather than because of any particularly unusual features or departures from ordinary practice.

At the time of their design, a careful study was made to determine whether they should be driven by steam or by internal-combustion engines, since these two sources of power were the only ones commercially available at that time. At first the use of steam appeared preposterous in a country where there is very little water, and where all of that is bad. Ordinary well water in eastern Arabia usually has about 3500 parts per million of total solids, and of this 750 parts or more is hardness. In fact, the steam power plant at Ras Tanura Refinery perhaps operates with water that is as bad as anything now used by a steam plant anywhere.

Although well water can be obtained at varying depths nearly everywhere along the right-of-way, and although there are hand-dug wells here that are of great antiquity and sometimes remarkable depth, yet the underground supply is unquestionably very limited, and the amount of water required for a cooling tower for a steam station would have been prohibitive. This led to the consideration of dry air-blown condensers utilizing finned tubes or other types of extended surface. It was estimated that steam could be condensed at a pressure of 5 psig under the most adverse circumstances in such a dry condenser. Of course during the night and in the winter conditions would be more favorable, and it would be possible to operate a condenser under vacuum if such operation was desired. The size of condenser required turned out to be practicable.

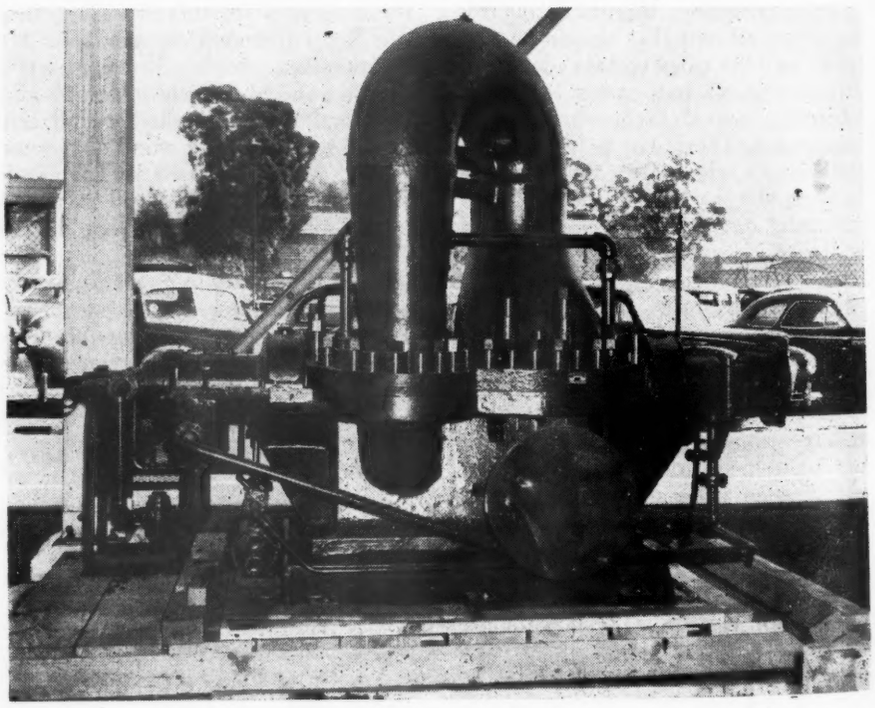
It was estimated that by operating boilers at a pressure of 900 psi and 750 F, exhausting at 5 psig, a water rate in the vicinity of 11 psi per hp-hr should be obtainable. The steam plant would have the advantage of fewer operating units and much less inherent complication, but even with the water rate quoted the overall fuel consumption would probably be 18,500 Btu per hydraulic hp-hr as compared to 9500 Btu for a diesel plant.

It was finally decided to go ahead with the more orthodox internal-combustion engines at all of the stations except at Station No. 1 in the Abqaiq field where there is a virtually unlimited amount of surplus sour gas for fuel. Station No. 1 contains two 6000-hp steam turbines directly coupled to two-stage centrifugal pumps, each capable of delivering about 340,000 bbl per day against a maximum of 840 psi pressure. The exhaust from these turbines will, under normal circumstances, be used for heating in a stabilizer that removes hydrogen sulphide from the crude oil, but it can be alternately routed to dry air-blown condensers of the type previously mentioned in case operation of the stabilizer does not parallel pumping requirements.

As a matter of possible interest it may be mentioned that the Arabian American Oil Company is just completing a 20,000-kw steam power station in the same location. This power station will exhaust to dry air-blown condensers at 5-lb gage, but steam will also be extracted at 50 lb for additional heating in the crude oil stabilizer.

High-speed pumps of the type used at Station No. 1 require adequate pressure on the suction. This is provided by two vertical pumps in the tank field, each capable of delivering full pipe line capacity at about 75 psi. All the usual accessories for a modern pumping station will be used. Among these are automatic flow and pressure controls, a recording flow meter for the main stream, and remote reading tank gages. Precision gaging of oil for royalty purposes in this area

FIG. 5. Oil pipe line pump 2-stage double volute type, 340,000 bbl per day at 840 psi differential pressure, 6000 hp, 3600 rpm, 87 per cent efficiency.



*Presented before Petroleum Division, The American Society of Mechanical Engineers, San Francisco, California, June 27-30, 1949, under the title "Some Features of the Engineering and Design of the Trans-Arabian Pipe Line."

†Engineer, Standard Oil Company of California.

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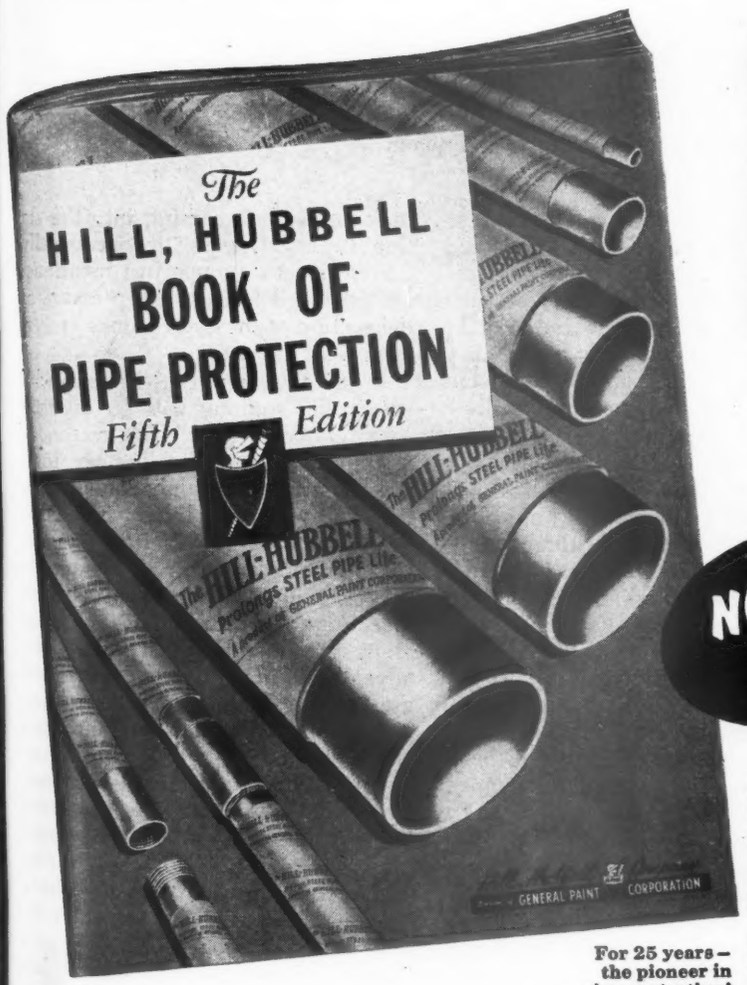

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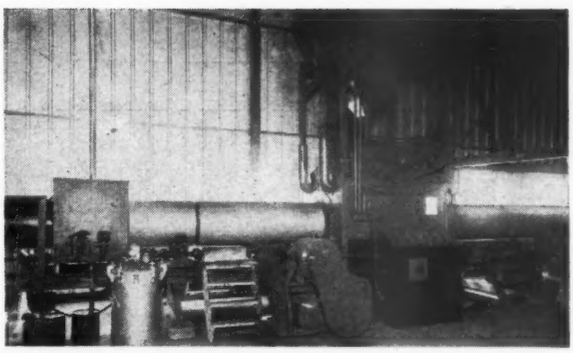
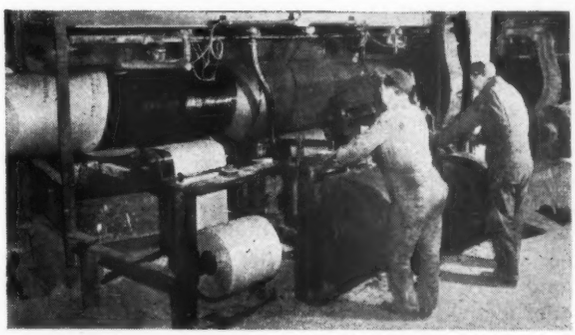


PAGE 12. This angular grit-blast machine removes every trace of mill scale, rust, dirt. Leaves pipe surface metal-bright for positive bond of protective coatings.



PAGE 15. This heavy-duty machine applies any standard specification of coating and wrapping. Hill, Hubbell is equipped to process all sizes of pipe from ¾" nominal to 30" O. D.

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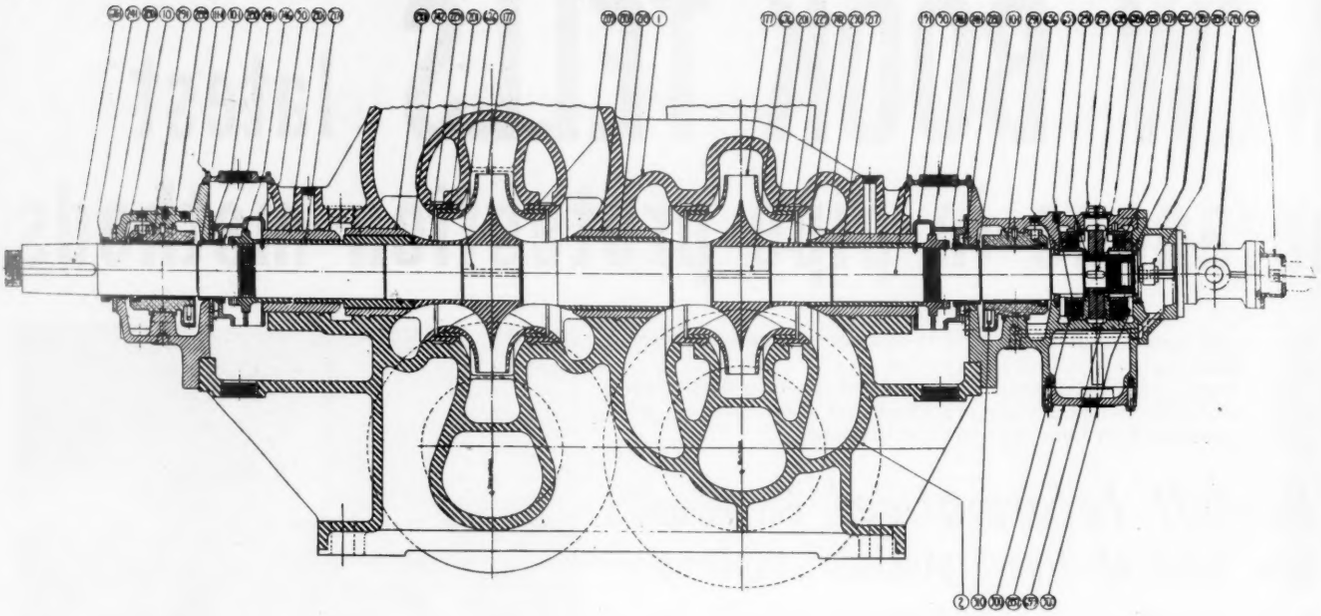

Part No.	Name of Part
1	Casing—upper half
2	Casing—lower half
10	Flinger—outer
10–1	Flinger—inner
50	Splash guard
111–4	Gland cover
151	Shaft
177	Impeller
201	Impeller wear ring
205	Case wear ring
217	Shaft sleeve—first stage
217–1	Shaft sleeve—second stage
218	Shaft sleeve—center
225	Pacer sleeve—first stage
225–1	Pacer sleeve—second stage
230	Throttle bushing—first stage
230–1	Throttle bushing—second stage—low pressure
230–2	Throttle bushing—second stage—high pressure
230–3	Stage piece—center
241	Deflector—outb'd
241–1	Deflector inb'd
251	Shaft locating ring
280	Oil guard—both halves—inb'd
280–1	Oil guard—both halves—outb'd

FIG. 6. Cross-section of 2-stage oil pipe line pump.

is accomplished by balancing the oil column against a mercury manometer that, when properly done, has been found more accurate than the conventional method of tape gaging used in this country.

The pumps at Station No. 1 are of conventional design, although they are perhaps the largest units of their type ever built. Fig. 5 is a 2-stage, 340,000 bbl per day, 840 pds, 3600 rpm, 87 per cent efficient. On account of the large shaft and the high peripheral velocities and comparatively high pressures, packing difficulties were feared, and it was finally decided to eliminate all packing and simply to install labyrinth bushings successively bled to lower pressures and, finally, to a sump whence the leakage is returned to the line. (Fig. 6.)

As indicated, Stations 2 to 6, inclusive, will be of the conventional type, operating with single-stage centrifugal pumps in series. (Fig. 7. Double volute, 210 psi, diff press. Fig. 8. Cross-sectional view.) The pumps are driven by 1700-hp diesel engines through speed-up gears. The pumps operate at a nominal 2200 rpm and the engines at 343 rpm. The engines are of the 4-cycle type, supercharged by the Elliott Buchi system. They have 8 cylinders, 16-in. bore by 20-in. stroke, and are capable of operating at BMEP of 120 psi. There will be five pumps in series, four normally operating to meet the requirements of the line and one spare. The individual pumps are bypassed with lines containing check valves and, of course, have motor-operated suction and discharge valves. Any unit therefore can be started and stopped without disturbing other units.

Besides the main driving units for the pumps, there will be three electric generators, one a spare, for driving auxiliaries, including the fans of the extended-surface dry air-blown radiators that will cool the jacket water and the lubricating oil. They will supply power for all incidental uses, including air cooling of the living quarters and refrigeration. Other important auxiliaries include pumps for the water wells and an auxiliary booster pump for putting pressure on the main pump suction when it is necessary to draw oil from the station tank. These generators will be driven by 6-cylinder engines having the same cylinder dimensions and other general characteristics as the engines used for pumping.

The stations are piped in such a manner that they can be operated either straight-through with "closed suction" or by floating a 96,000-bbl tank on the line coming into the station. In the latter case, the electrically-driven booster pumps just mentioned are provided to raise the pressure on the suction of the main pumps enough to prevent cavitation.

It is not certain at this time to what extent the stations will be operated with "closed suction." This method of operation is almost obligatory for a products line to minimize contamination, and in an ordinary crude line has advantages in permitting the dispatchers to correlate receipts and deliveries without difficult and usually inaccurate corrections for tankage along the line. However, it has disadvantages, too. Unless precautions are taken to limit the results of surge pressure to one section, pressures generated by the various stations can, under certain circumstances, be cumulative and result in over-pressuring the line. Where the line is laid aboveground there is another reason for operating with open tankage at each station that does not appear where the pipe line is buried. As few long commercial pipe lines have been laid aboveground, this phenomenon is perhaps not generally appreciated. In a line with multiple stations, each section of which is exposed to sunlight, every station receives more volume of oil during the day than is pumped,

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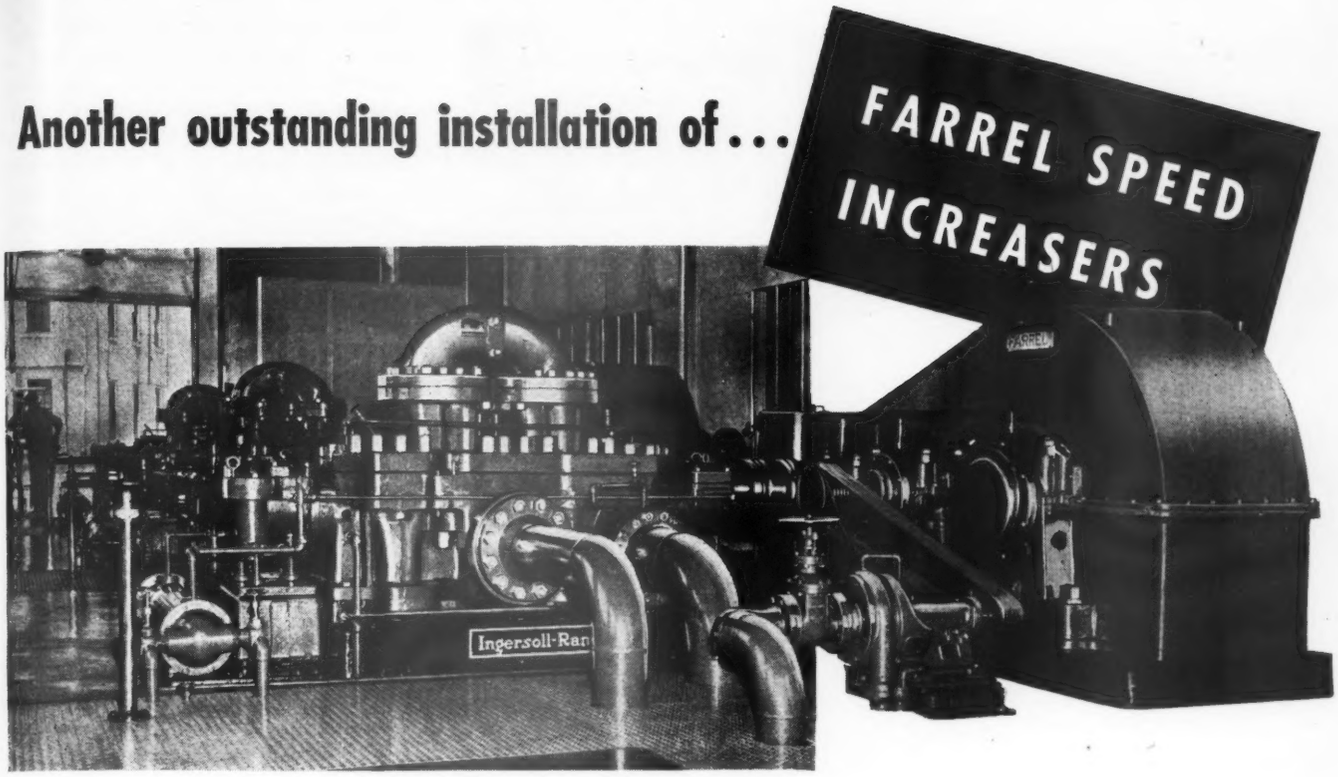

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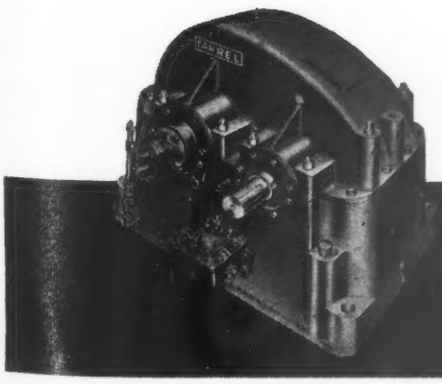

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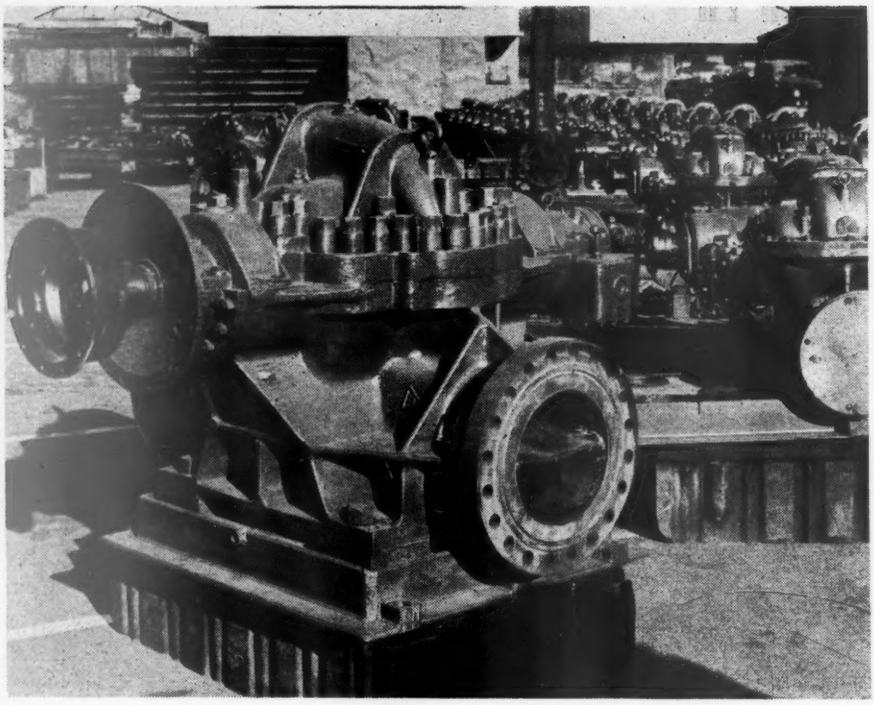


FIG. 7. Oil pipe line pump single stage double volute type, 340,000 bbl per day and 210 psi differential pressure, 1700 bhp, 2200 rpm.

and, conversely, pumps more during the night than it receives. The difference is substantial and if it were allowed to accumulate over 1000 miles it would result in a substantial loss of capacity, since the capacity of the line during the day would be limited by the last section and during the night by the first section. The magnitude of this effect is uncertain because the exact distribution and quantity of unburied line is not yet established.

While this is a digression from the subject of this paper, it may be mentioned that this phenomenon was observed in an exaggerated form in some of the "Canol" pipe lines laid by the U. S. Army during the war. One of these lines in Canada was only 2 inches in diameter and extended a distance of 300 miles, all above the ground. During the day when the sun came up the receiving station not only got more than the full line capacity when the initial station was completely shut down, but, in fact, it became necessary to bleed oil back into the tank at the initial station to avoid an excessive rise in pressure. On the other hand, during the night the initial station could pump at full speed while the terminal station received nothing whatever.

In order to avoid over-pressuring the pipe line in case of accident or faulty operation, especially when operating with closed suction, it is now contemplated that relief valves of special design will be installed on both the incoming and outgoing main lines. In addition, over-pressure trips will be installed to shut down one or more of the engines in case of over-pressure on the discharge of the station.

Conventional scraper traps are being installed. The Arabian oil is known to be somewhat waxy. The pipe lines so far operated between the field and the Persian Gulf terminals have not experienced wax deposits, probably because the oil has never had the chance to cool off in the short distance involved, but wax has accumulated in the tanks. In the higher elevations in Western Arabia and Trans-Jordan, the oil temperature may fall as low as 55 F in the winter time. It is understood that the temperature of oil received at the Haifa terminal of the Iraq Petroleum Company falls as low as 57 F in the winter, although the annual average is a little over 70 F. Scrapers, and hence scraper traps, are also of value to remove air during the filling of the line, to separate the water used for testing from the oil following, as well as to assist in removing a certain amount of rubbish which always seems to get into pipe lines during construction.

Pump and engine houses at the stations are 230 ft long and 70 ft wide, the pump room being separated from the engine room by a gas-tight firewall. As previously indicated, there will be three 800-kw generators together with a sizable air conditioning plant, a refrigeration plant, and a laundry. At the present time the plans are for the construction of six dwelling houses in addition to the superintendent's house, and a four-room bunkhouse for single employes. There will be a children's playground, a tennis court, a baseball diamond, and a swimming pool besides a community center and an infirmary.

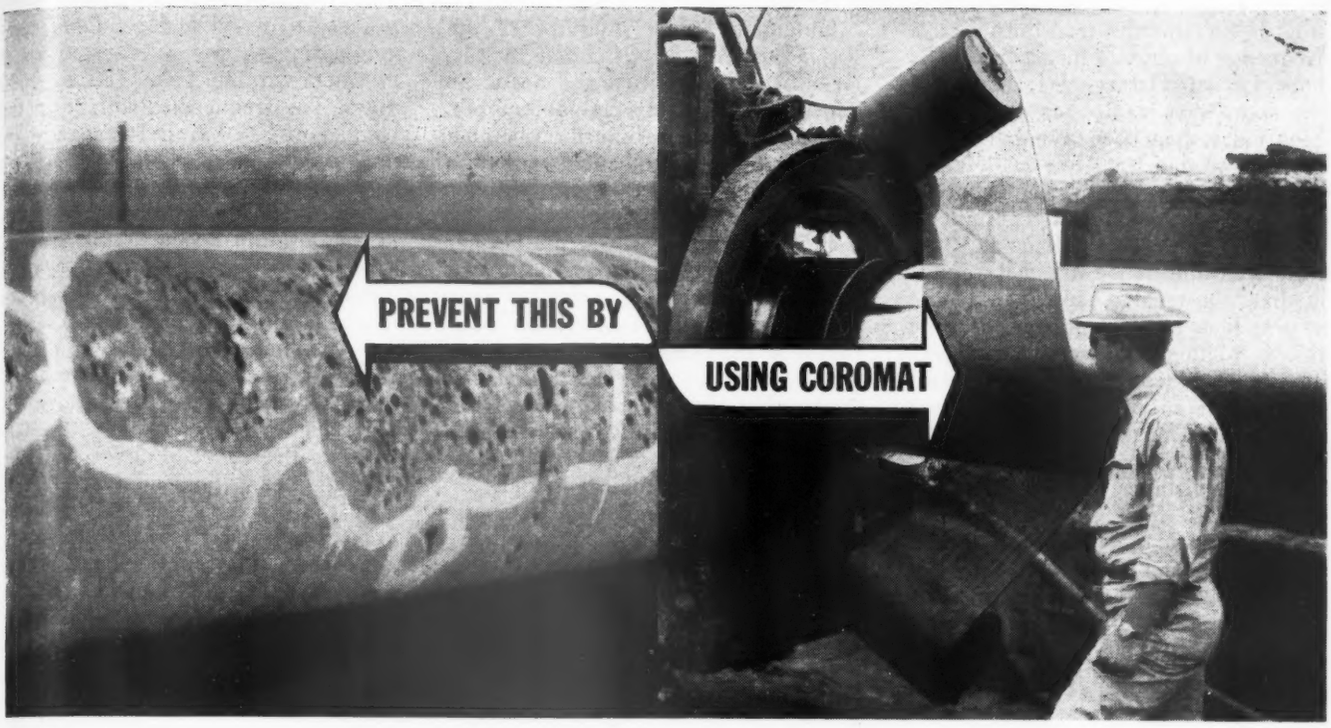
In addition to the housing for Americans there will be quarters for about 24 Arab families and 200 Arab bachelors. The number of these Arab quarters may serve to emphasize the statement made earlier in this paper that the cost of constructing and operating a pipe line station in the middle of the desert is something wholly beyond and apart from any mere pumping cost in terms of kilowatt hours such as one might talk about here in the United States.

Communications

Communications along the pipe line received very careful consideration from the beginning, and both wire lines and various forms of radio were considered. The wire line had three drawbacks. The first, of course, was expense, and the second was exposure to various forms of damage, including either unintentional or intentional sabotage from curious or malicious bands of nomads, but the consideration that loomed most important of all was that it would not be available during construction when communication was just as urgently needed as for operation.

Very high frequency radio of the line-of-sight variety was believed by some of the radio engineers consulted to be the only type that would guarantee performance under all weather conditions, but it required towers and a supply of power at intermediate locations where no power was available from a reliable source. If unattended, such intermediate relay stations would also be subject to derangement by the curious or malicious, or those bent on pilfering. Again it was impossible to obtain the necessary equipment in time to be used in the construction program, and possibly not in time for operation at the time when it was then hoped to complete the pipe line.

It therefore seemed that some form of ordinary short-wave transmission was necessary for the construction program, and that experience might indicate that it could be expanded into a permanent system that would give reasonable satisfaction. This hope was partly based on the rather remarkable performance of the low-power transmitters that the Arabian American Oil Company geologists



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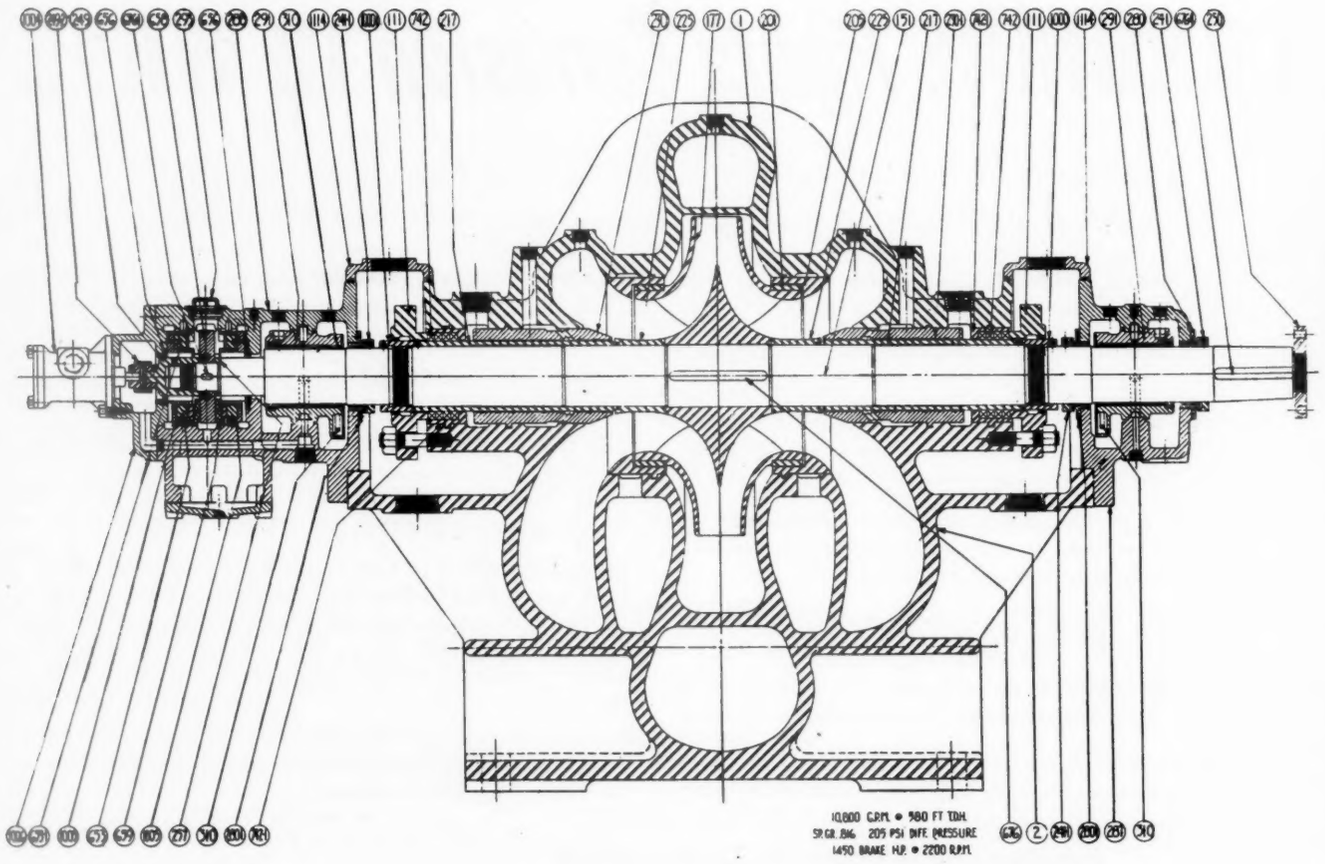
used in automobiles transmitting at a frequency of about 4 megacycles. The hope for satisfactory performance of the short-wave radio has apparently been more than borne out by the experience to date.

The temporary equipment consists principally of 1000-watt transmitters at Beirut and Ras el Misha'ab, 300-watt transmitters at the main intermediate construcion camps, (only one of which is in operation at the time this is written), 50-watt transmitters at temporary tent camps, and 15-watt transmitters in certain of the motor equipment. The through communicaton from Ras el Misha'ab to Beirut, an airline distance of 850 miles, has been almost faultless. Various frequencies can be used between 3 and 18 megacycles, and 2 are normally set up, but the change-over is manual. Communication with the 50 and 300-watt line transmitters is also excellent, and at times even the 15-watt automobile transmitters have been able to communicate three quarters of the way across Arabia. Of course the latter situation is unusual and not to be depended on, but the automobile transmitters have ordinarily been able to get in communication with the nearest construction camps without difficulty.

It is contemplated that the permanent installation will consist of two more or less separate systems, one a through system from Sidon to Dhahran, and the other a dispatching system for the pipe line, taking in all the intermediate stations as well as the terminals. The through system will utilize transmitters of 1000 watts output feeding to rhombic antennas designed to obtain single-hop transmisson. Three rhombic antennas will be used for reception in conjunction with a diversity receiving arrangement which automatically selects the strongest signal and virtually eliminates fading. The dispatching system will utilize three frequencies simultaneously to provide dependable communication to any or all stations at distances varying from 125 to 1000 miles. The frequencies will be in the vicinity of 5, 10, and 16 megacycles.

Mediterranean Terminus

As previously said, the Mediterranean terminus of the Trans-Arabian Pipe Line will be a few miles south of Sidon at a point where the Zahrani River empties into the Mediterranean. It is planned to install 16 tanks of 180,000-bbl capacity, each at elevations 285 to 378 ft above the water. The tanks will be about 5200 to 7200 ft from the shore. Four submarine loading lines will extend some 2700 ft from the beach to a point where the water is 50 to 55 ft deep, and in addition there will be separate ballast lines. The initial installation will probably be the simplest necessary for loading tankers by gravity with crude oil at a high rate, although the possibility of a refinery at this point at some later



281—Oil pump
281–1—Coupling—oil pump
287—Bearing housing—thrust—both halves
288—Bearing housing—radial—both halves
291—Bearing shell—both halves
293—Oil sight cover
300—Housing ring—thrust shoes
310—Oil ring
385—Tachometer pick-up bracket
389—Oil pump bracket
653—Levelling plate
653–1—Rocker plate
656—Oil comb
658—Thrust collar
658–1—Key—thrust collar
659—Thrust shoe
676—Key—impeller
676–1—Key—coupling
742—Packing—shaft sleeve
746—Nut-shaft sleeve—1M
746–1—Nut-shaft sleeve—RH

FIG. 8. Cross-section of single stage oil pipe line pump.

date has always been borne in mind. Incidental facilities required for a submarine loading terminal are a separator for handling oily ballast, a communication system from ship to shore and from shore to tankage for controlling flow of oil, and a small pier for the launches that are necessary for handling ships' mooring lines, transferring personnel, and moving supplies.

The design of the facilities at Sidon has not been entirely completed at the time this paper is written, but probably there will be four 30-in. lines from the tankage to the beach where there will be a manifold and then four 30-in. submarine lines.

The permanent radio transmitting station will be at Sidon rather than at Beirut where the present station is, but the headquarters of the company will in all probability remain in Beirut, which is only about 30 miles to the north, and is the metropolitan and commercial center of Lebanon. The exact design of the radio communication system is still being studied, and there is a possibility that some changes from the plan outlined will be made.

The Trans-Arabian Pipe Line Company and its staff has extended every possible assistance in the preparation of this paper, and they are to be commended for the candor with which they have supplied information concerning some of their engineering and construction difficulties, as well as their generally well-thought-out and successful program for design and construction.

The entire development of Arabian oil by American interests is a tremendous venture in which every American ought to take justifiable pride. This paper is properly confined largely to the technical and engineering aspects of the project. The other aspects have been covered in the general press, but it seems hard to leave the subject without expressing the opinion that the whole Arabian development will be of the greatest mutual benefit to Arabia and to the United States, as well as to Europe. It may be that little of the Arabian oil will reach the United States directly, but its effect on the economy of our country is just as great if it minimizes or prevents the use of oil from the Western Hemisphere in Europe or the Far East. In either case it will conserve our own reserves and it seems evident that the most intelligent long-range American policy should be to conserve our domestic supply of oil, to use it wisely, and not some years hence find ourselves completely at the mercy of other countries for our supply of hydrocarbon materials. ★ ★ ★

Humble to Build New Pipe Line

Before the end of this year, Humble Oil and Refining Company will begin construction on a 375-mile, 18-in. crude oil pipe line from Kemper, Texas, to Satsuma, 20 miles north of Houston, Texas. This new line will tie in with Humble's line in Baytown. Cost of the project has been estimated at $18,000,000.

Humble's old line from West Texas to Baytown will be taken out of service upon completion of the new line sometime in 1950. The new line will have a capacity of 95,000 bbl of crude oil daily, which can be increased to 120,000 bbl a day by additional pump stations. No changes are contemplated in Humble's other line from West Texas to Corpus Christi, Texas. This line has a capacity of 70,000 bbl a day.

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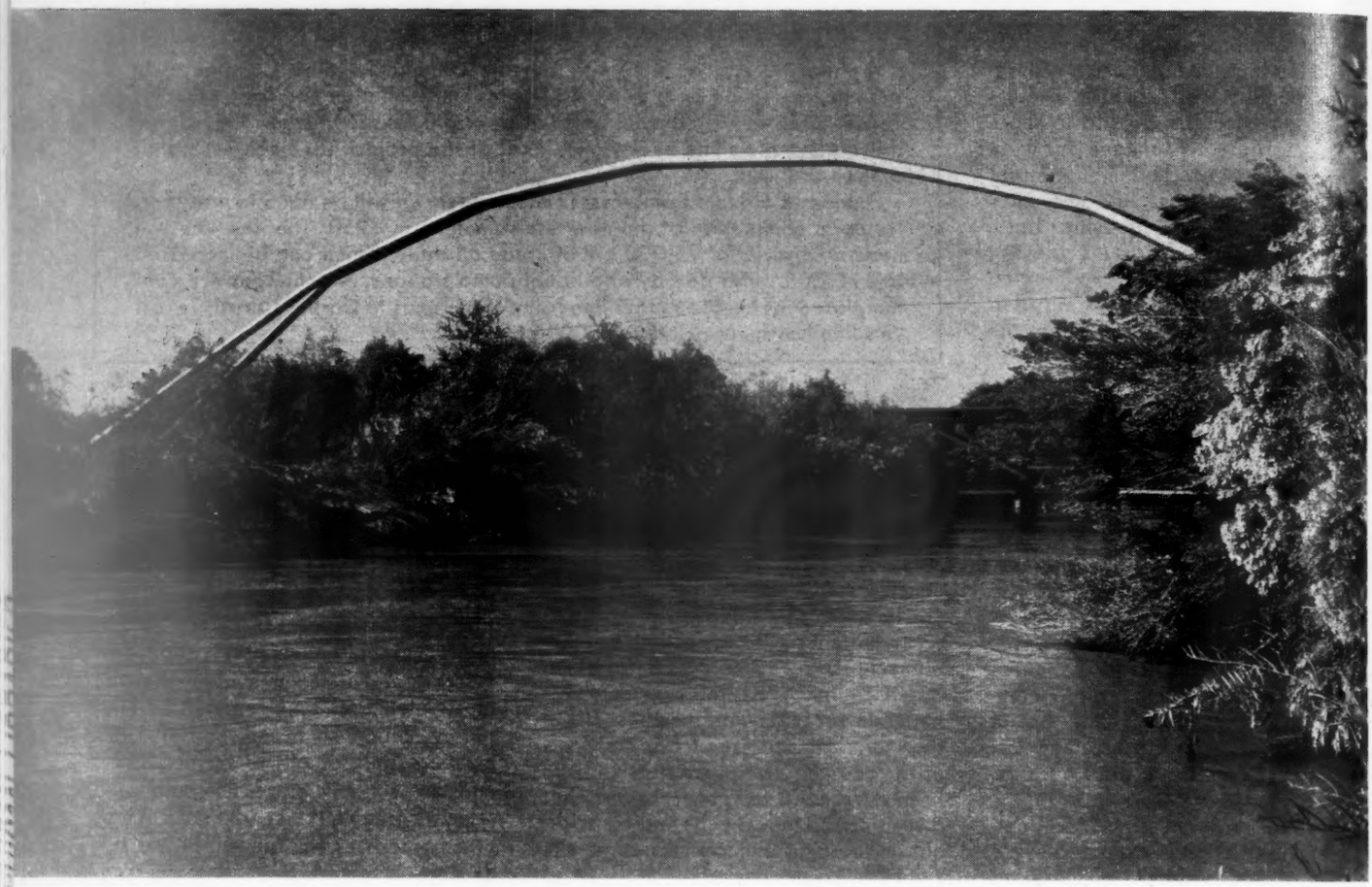

Self-supporting, all-welded pipe line stream crossing erected by Southern California Gas Company.

Self-Supporting Pipe Line Stream Crossing

ARTHUR ROHMAN

THE self-supporting, all-welded, arch-construction pipe line stream crossing shown in the accompanying photograph is part of Southern California Gas Company's new Imperial Valley line that ties into the 30-in. Texas-to-California line west of Desert Center and extends southward 75 miles to Calexico, California.

According to Elting Henderson, manager of distribution, this novel crossing is, so far as known, the first of its type. It was designed by company engineers to span the Alamo River between Calipatria and Brawley. Briefly, it consists of connecting the 10-in. main line on either side of the stream with two mutually supporting 6-in. pipe lines, forming an arch composed of five 10-ft sections of pipe. The center of the arch is approximately 25 ft above the water line of the 100-ft stream bed. The pipe lines in the arch proper are held in place by inverted Y pipe sections welded into headers on either side of the stream. Well back from the high water mark on either side of the stream, a 10-ft header made from 12-in. pipe was welded horizontally to the 10-in. main line. The crossing section was welded on the job as a unit.

High velocity wind is the principal hazard but the two pipes buttressed against each other are designed to withstand wind velocities well in excess of any experienced in that area.

Construction costs were modest, the work requiring only a few days to complete by the regular construction crew and with equipment used in building the main line.

The Southern California Gas Company, which recently purchased the butane-air distribution systems in a number of Imperial Valley towns, has completed the change-over to natural gas in the towns of El Centro, Brawley, and Calexico, and work is in progress toward building tie-in trunk lines and distribution systems in the towns of Niland, Calipatria, Westmoreland, Holtville, and Imperial. Upon completion of the Imperial Valley project, the new line will serve 6000 meters and a population of approximately 30,000 people, as well as a large industrial load. The company anticipates a growth to 10,000 meters within the next five years. ***

EXCLUSIVE

NEWS

Lights First Jet of Natural Gas in New York. Mayor William O'Dwyer sets the first jet aflame during ceremonies at Staten Island, August 22, marking the opening of mains for the first natural gas to come into the New York area. The gas is being piped from Texas and Louisiana fields through the Big Inch and Little Big Inch pipe lines, and comes to Staten Island from the "inch" terminus in Linden, New Jersey, by means of a feeder pipe. The New York and Richmond Gas Company will receive up to 4,000,000 cubic feet of natural gas daily.

Stanolind Shuts Down Three Pump Stations

Three Stanolind Pipe Line Company pump stations were shut down September 1, President J. L. Burke announces, due to reduction in transportation requirements in Texas.

Stations at El Reno, Oklahoma, and Childress, Texas, on the company's 16-in. line from West Texas to Drumright, Oklahoma, have not been pumping recently. Monroe station near Lubbock alone can handle the crude oil pumped through the lines daily at the present time. Both Childress and El Reno have four pumps powered by four 1000-hp electric motors capable of pumping 162,000 bbl of crude oil a day. Of the five men employed at each of the two stations, the chief engineers, A. M. Whitwell at Childress and J. J. Peard at El Reno, remain on duty.

Lakenon station has diesel-powered pumps with a capacity of 53,500 bbl a day. Situated on the Gulf Coast-Drumright line, near Hillsboro, Texas, it employs 11 men. L. H. Springer, chief station engineer, remains on duty.

Employes at these stations have been placed at other points in Stanolind Pipe Line Company's 11,300-mile, 10-state system. All three stations will remain on a standby basis. In the event that pumping requirements increase the three stations will be able to resume operation at once.

Eastern Natural Gas Would Construct Line

Eastern Natural Gas Company, of Richmond, Virginia, has filed an application with the Federal Power Commission asking authorization to construct a 165-mile natural gas transmission line extending from the vicinity of Stanardsville, Virginia, southeast to the Norfolk, Virginia, area. Estimated overall cost of the project is $5,940,000.

The company, which also is proposing to build lateral lines extending from the proposed main line to market areas along the route, was recently organized for the purpose of constructing the Virginia project.

4900 Miles Gas Lines Authorized First 6 Months

The Federal Power Commission authorized construction of natural gas transmission facilities designed to add approximately 2,000,000,000 cu ft daily delivery capacity to the individual pipe line systems in the United States during the six-month period ending June 30, 1949, it is announced by Chairman Nelson Lee Smith.

The authorized facilities involve an estimated total construction cost of approximately $374,820,900, and will add about 4900 miles of new pipe line to the nation's natural gas systems.

Major projects will increase capacities of the systems involved by at least 1,907,100,000 cu ft a day, and involve construction of approximately 4641 miles of new pipe line and installation of compressor units aggregating 363,800 hp.

The largest single authorization during the six-month period was for construction by Trunkline Gas Supply Company of a pipe line extending from Texas to Nebraska. This project, which involves 1521 miles of line and seven compressor stations with units aggregating 44,800 hp, is to be built at an estimated cost of $84,340,300 and is designed to deliver 250,000,000 cu ft a day to Northern Natural Gas Company.

Since February 7, 1942 (the date when the present certificate provisions of the Natural Gas Act became effective), the commission has authorized a total of 27,500 miles of pipe line and 1,603,000 hp in compressor units at a total estimated cost of $1,628,511,300.

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Revenues Decline

For the second quarter of the year (April to June) pipe line revenues showed a decline of 2.7 per cent compared with the same quarter of 1948, according to the Interstate Commerce Commission Bureau of Economics and Statistics. Revenue for 1949 was $82,143,410 and for the same period of a year ago $84,409,421. These figures are for carriers having annual operating revenues of $500,000 or more. The volume of oil originated on the lines of the 45 companies represented in the statistics was 566,882,804 bbl this year and 639,291,684 bbl last year.

Dismisses Application

The Federal Power Commission has dismissed an application, because of the company's failure to proceed with its prosecution, filed by Gulfcoast Northern Gas Company in which it was proposed to construct a 1184-mile pipe line to transport natural gas from Texas to Illinois to supply gas to Natural Gas Pipeline Company of America for resale in the Chicago area.

In dismissing the application, which was filed August 27, 1948, the commission pointed out that Gulfcoast, in response to an inquiry by FPC last May, clearly indicated that it did not intend to prosecute the application.

Somastic Coating Plant Installed at New Orleans

A complete Somastic coating plant has been installed south of New Orleans on the Intra-Coastal Canal, by

Robert P. White

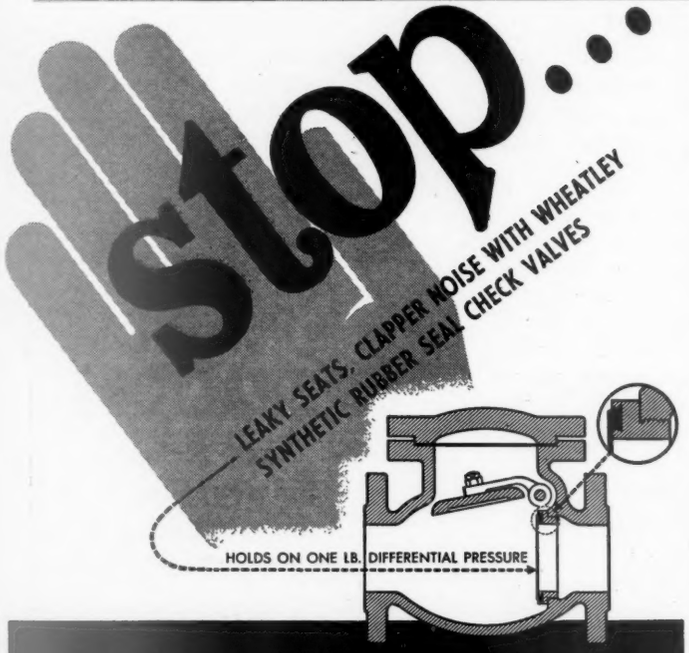
H. C. Price Company. This permanent plant will afford Somastic pipe coating facilities for corrosion protection throughout the Gulf States area for all pipe sizes up to and including 30-in. in diameter. The yard has ample space for stockpiling bare and coated pipe and is conveniently situated for rail and marine transportation, it is announced.

As an added feature, equipment will be installed to manufacture and apply concrete over Somastic coating for weight and additional protection to the pipe in marine and swamp installations. Pipe will be cleaned by the steel grit shot-blasting method, which has been a Somastic custom for the last 19 years.

Robert P. "Bob" White has been appointed Gulf division manager in charge of sales and coordination of operations with headquarters at New Orleans.

White has been associated with Somastic coating operations since 1940. After graduating from the University of Cincinnati in the College of Engineering and Commerce, he began work at Archer City, Texas, as materials checker, and acted in the capacity of inspector, engineer, office manager, and superintendent, until he entered service in World War II in March, 1943, as an ensign in the navy.

After serving in the Pacific he returned to the States in December, 1945, as a lieutenant. During 1946 he was superintendent of field operations in Pennsylvania and New York, after which he was transferred to the head office at Bartlesville as administrative manager of the Somastic division. Through experience, White has gained a thorough knowledge of Somastic operations.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Semi-steel and steel check valves; API 2" to 30"; bronze clapper, replaceable synthetic ring seal. Holds with weight of clapper alone. Resists abrasive action, wear. Seals around foreign particles, muffles clapper noise. Flanged, screwed, or both.

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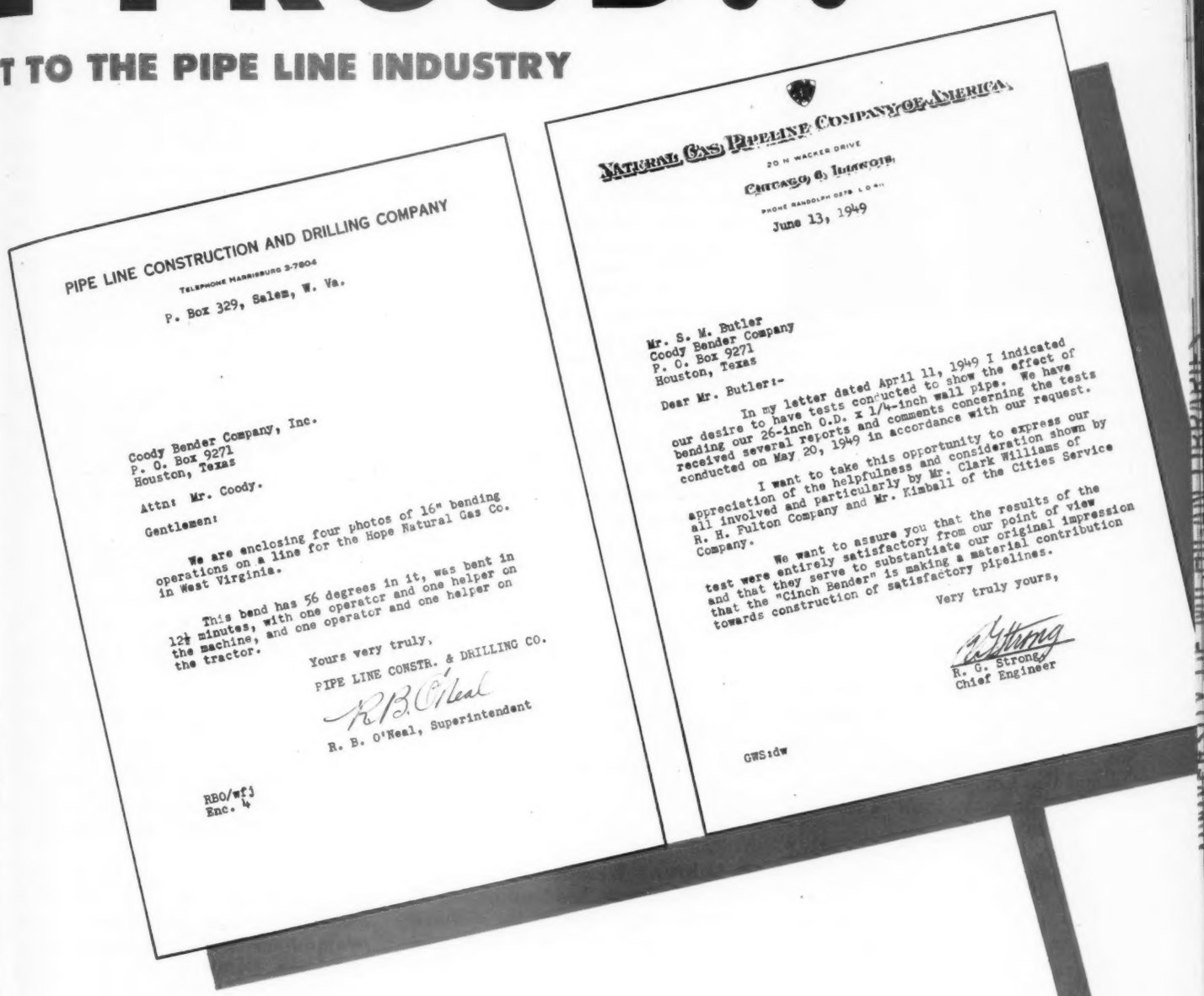

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TELEPHONE HARRISBURG 3-7804

P. Box 329, Salem, W. Va.

Coody Bender Company, Inc.
P. O. Box 9271
Houston, Texas

Attn: Mr. Coody.

Gentlemen:

We are enclosing four photos of 16" bending operations on a line for the Hope Natural Gas Co. in West Virginia.

This bend has 56 degrees in it, was bent in 12½ minutes, with one operator and one helper on the machine, and one operator and one helper on the tractor.

Yours very truly,
PIPE LINE CONSTR. & DRILLING CO.
R. B. O'Neal
R. B. O'Neal, Superintendent

RBO/wfj
Enc. 4

NATURAL GAS PIPELINE COMPANY OF AMERICA

20 N. WACKER DRIVE
CHICAGO 6, ILLINOIS
PHONE RANDOLPH 0278 L.D.

June 13, 1949

Mr. S. M. Butler
Coody Bender Company
P. O. Box 9271
Houston, Texas

Dear Mr. Butler:-

In my letter dated April 11, 1949 I indicated our desire to have tests conducted to show the effect of bending our 26-inch O.D. x 1/4-inch wall pipe. We have received several reports and comments concerning the tests conducted on May 20, 1949 in accordance with our request.

I want to take this opportunity to express our appreciation of the helpfulness and consideration shown by all involved and particularly by Mr. Clark Williams of R. H. Fulton Company and Mr. Kimball of the Cities Service Company.

We want to assure you that the results of the test were entirely satisfactory from our point of view and that they serve to substantiate our original impression that the "Cinch Bender" is making a material contribution towards construction of satisfactory pipelines.

Very truly yours,
R. G. Strong
Chief Engineer

GWS:dw

IF YOU AREN'T NOW OPERATING WITH A SMOOTH-BEND, TIME AND LABOR SAVING CINCH BENDER, BE SURE TO WRITE FOR FULL ENGINEERING DETAILS TODAY. WHAT THE CINCH BENDER IS DOING FOR OTHERS, IT CAN DO FOR YOU.

Transportation Personals

Pipe Line Personality

▸ **Smith W. Day,** vice president in charge of the southern division of Interstate Oil Pipe Line Company with headquarters in Shreveport, Louisiana, is now in the 45th year of his career with various pipe line affiliates of Standard Oil Company (New Jersey).

His first job, beginning June 1, 1905, was as a laborer with the New York Transit Company, which at that time was building a 6-in. pipe line in New York and New Jersey.

Between 1905 and June, 1909, Day served with several pipe line affiliates in the North and East including the Southern Pipe Line Company, Prairie Oil and Gas Company, and the A. C. Bedford Company (now Tuscarora Oil Company, Ltd.).

In June, 1909, when the Standard Oil Company of Louisiana began construction of what is now Interstate's southern division pipe line system, Day transferred to that company as a stabber, or construction gang foreman. By 1920 he had risen to the post of superintendent in the pipe line department of Louisiana Standard, and in 1926, three years after the pipe line properties had been acquired by Standard Pipe Line Company, Inc., he was named vice president of that company.

In 1936, when Standard Pipe Line Company, Inc., was merged with Standard Oil Company of Louisiana, Day was elected vice president of the latter company and named general manager of the pipe line department.

On January 1, 1945, when Louisiana Standard's pipe line system was acquired by Interstate, he was elected vice president of the latter company and was placed in charge of the southern division.

In this position he has had supervision over the construction of nearly all of Interstate's present pipe line system in Mississippi—a system that now includes approximately 237 miles of trunk line, and which during 1948 handled about 80 per cent of all Mississippi oil moved by pipe line, and 70 per cent of the state's total production.

▸ **R. M. Carter** succeeds **C. E. Spencer** as superintendent of tankage for the Stanolind Pipe Line Company, it has been announced by **Ernest A. Slade,** maintenance superintendent.

Spencer resigned August 1 to accept a position as general manager with the Keyes Tank and Supply Company of Provo, Utah. He will reside in Salt Lake City. Carter, former administrative assistant under **A. M. Hill,** superintendent of line maintenance, will have charge of maintaining Stanolind Pipe Line Company's 375 working tanks. The tanks, placed throughout the company's 11,300-mile pipe line system, afford the company 14½ million barrels of working tankage.

Stanolind Pipe Line Company has authorized the Natasco Company,to begin a cleaning program in the company's Kansas, Illinois and Missouri divisions that will require approximately one year. The Natasco Company will clean and dispose of the basic sediment and water in 37 tanks at 13 locations in the three divisions. These tanks will be repaired and modernized by Stanolind crews. Completion of the project is estimated for July, 1950.

▸ **Aubrey Weatherholt,** Bartlesville, Oklahoma, has been named district superintendent in the Oil Hill, Kansas, area by Empire Pipeline Company. He succeeds **C. A. Mason,** long-time superintendent at Oil Hill, who retired recently.

Thos. J. Lanagan has been transferred from Cushing, Oklahoma, to Odessa, Texas, as district superintendent in charge of that area. Lanagan is a 33-year man with Empire Pipeline, having spent more than 20 years in the Cushing superintendency.

W. L. Kline, who has been serving as assistant superintendent in the Ponca-Cushing district, has been elevated to the superintendency of the Cushing district.

O. V. Adkins, who has been stationed in the Chico area of Wise County, Texas, has been named district superintendent of operations in North Texas. Adkins is a long-time pipeliner, having first worked for the company in 1920.

▸ **Reginald C. Warner** has been appointed assistant manager of the marine department of Standard Oil Company of California. For many years a chief engineer on vessels of Standard's tanker fleet, Warner more recently has acted as inspector of operations and maintenance for the company's marine department.

During the last ten years he also has supervised construction, here and abroad, of tankers and petroleum barges for Standard and some of its subsidiary companies.

Warner joined Standard in 1921 as a first assistant engineer. In his new position he replaces **A. E. Kihn,** recently named manager of Standard's marine department.

▸ **E. Nelson Frost** has been named traffic manager of Allied Oil Company, Inc., Cleveland, Ohio. Frost has been associated with Allied Oil since October, 1947, and for the last 18 months has held the post of assistant traffic manager.

▸ **B. L. Rogers,** superintendent of compressor stations for Lone Star Gas Company, Dallas, has retired after 35 years' service with the company. He helped build the company's first compressor station at Petrolia in 1914 and after it was completed remained there as a draftsman. Later he became plant engineer. He was made chief station engineer in 1918 and in 1924 was transferred to Dallas and appointed superintendent of the company's newly organized compressor department.

▸ **T. D. Brown,** assistant to the area superintendent at Houston, Texas, for Shell Pipe Line Corporation, has been named division superintendent at Healdton, Oklahoma. **R. E. White,** who has been division superintendent at Healdton has been appointed assistant to the area superintendent at Springfield, Missouri. Other appointments by Shell include: **R. V. Lahr,** acting area engineer, Colorado City, Texas, to assistant area superintendent at Houston; **J. E. Mims,** engineer, Houston, to division engineer, Springfield; **R. S. Belshe,** engineer, Cushing, Oklahoma, to district foreman, Elk City; **R. W. Rainwater,** station maintenance electrician, Odessa, Texas, to electrical maintenance supervisor, Kermit, Texas; **F. N. Taylor,** senior engineer, Cushing, to Houston; **J. A. McCormick,** district chief gauger, Yates, Texas, to station chief engineer, Baylor; **L. C. Orr,** assistant area gauging inspector, to tank farm chief gauger, Cushing.

With the PIPE LINE CONTRACTORS

Ray L. Smith and Son, Inc., Box 391, El Dorado, Kansas, is finding progress slow due to extremely rough terrain and rainy weather on its Atlantic Seaboard Corporation job. Approximately 24 miles has been completed (August 25) but the contractor was expecting to show improvement. This is a 26-in. line being laid from Clendenin, West Virginia, to a point approximately 65 miles to the northeast. The office and warehouse are now situated at Gassaway, West Virginia. Joe L. Work is general superintendent, Wm. G. Frost spread superintendent, M. O. Newby welding foreman, and J. H. Salisburg office manager.

Latex Construction Company, 2707 Ferndale Place, Houston, Texas, has the following work under contract: For Texas Gas Transmission Corporation, 101 miles of 26-in. gas line, from Sharon, Louisiana, northeast to the Mississippi River south of Lake Village, Arkansas. W. H. Hayes, superintendent; M. L. Thompson, assistant superintendent; A. E. Stremmel, office manager. Approximately 70 miles completed to August 30. Headquarters moving to Eudora, Arkansas.

For Interstate Natural Gas Company, 29 miles of 16, 20, and 22-in. west of Baton Rouge, Louisiana. F. A. Silar, general superintendent; W. A. Briley, spread superintendent; J. B. Stoddard, office manager. Headquarters, Erwinville, Louisiana. Job 35 per cent complete.

Construction of four pipe line pump stations for The Texas Pipe Line Company at Lindsay, Oklahoma; Haskell, Colorado City, and Odessa, Texas. J. B. Latham, superintendent; W. E. Bayles, office manager. General headquarters and office at Wichita Falls, Texas. Job approximately 75 per cent completed.

For Arkansas Louisiana Gas Company, 91 miles of 20-in. gas line from vicinity of Magnolia, Arkansas, to vicinity of Malvern, Arkansas. Preliminary work has started with two spreads; pipe expected September 7. E. C. Norris, general superintendent. Headquarters: Arkadelphia, Arkansas, H. L. Leake, spread superintendent; S. B. Harrison and L. F. Redfearn, office; Prescott, Arkansas, R. E. Thornton, spread superintendent, R. J. Axsom, office.

For Mid-Valley Pipeline Company, 120 miles of 20-in. crude oil line from Haynesville, Louisiana, to Mississippi River north of Lake Providence, Louisiana. Preliminary work began September 5. Job will be done with two spreads. Also for Mid-Valley 22 miles of 8-in. and 12 miles of 6-in. lateral crude oil lines from Haynesville, Louisiana, to Stevens, Arkansas. Work has begun. Headquarters are Magnolia, Arkansas. O. R. Mitchell is spread superintendent.

Forty-one miles of 12-in. lateral crude oil line for Mid-Valley from the vicinity of Delhi, Louisiana, to Lake Providence, Louisiana. Headquarters to be at Lake Providence.

Mississippi River crossings consisting of two 20-in. crude oil lines for Mid-Valley Pipeline Company north of Lake Providence, Louisiana. Pipe expected about September 25. J. A. Cantrell, superintendent.

Red River crossings consisting of two 16-in. gas lines, near Curtis, Louisiana, for Texas Gas Transmission Corporation. Starting date unknown. Personnel not yet selected.

Red River crossing consisting of one 20-in. crude oil line, near Benton, Louisiana, for Mid-Valley.

Oklahoma Contracting Company, 1210 Mercantile Bank Building, Dallas, Texas, began laying pipe September 1 on the Salt Lake Pipe Line Company job. Between Burley and Boise, Idaho, 151 miles of 8-in. products line will be laid. An office has been established at Twin Falls, Idaho. Aldress Kilgore is superintendent and Dick Mueller office anager.

Oklahoma Contracting has taken on an additional 25 miles to the work it has been doing for the Michigan-Wisconsin Pipe Line Company. Its portion of the line now extends to the Illinois line and approximates 200 miles between that point and Crown Point, Ind. It is expected that the work will be completed by October 1, about 40 miles remaining at this time (September 1). The office has been moved to Valparaiso, Indiana. H. A. Wylie is general superintendent, Robert Hall office manager, and C. W. Goodwin welding foreman.

On the first of the month approximately 75 per cent of the work had been completed on Texas Gas Transmission Corporation's line. This job consists of 102 miles of 26-in. between Fulton and Providence, Kentucky. The field office is now at Princeton, Kentucky. L. B. Rea is superintendent, "Bull" Stewart assistant superintendent, R. B. Pryor office manager, and H. A. Rowden welding foreman.

Smith Contracting Corporation, 1410 Fort Worth National Bank Building, Fort Worth, Texas, got under way August 25 on the Salt Lake Pipe Line Company project. This contractor was awarded 168 miles of 8-in. from Salt Lake City, Utah, to Burley, Idaho. An office has been opened at Ogden, Utah, with Arnold Smith superintendent and Ben Mapes office manager.

For purposes of laying the 131 miles of 12¾-in. line from Chico to Corsicana, Texas, for The Texas Pipe Line Company, the contractor has divided the work into a north and south section. The office for the south section has bene moved from Corsicana to Cleburne. About 60 per cent of this 69-mile section has been laid to September 1. Charley Craig is superintendent and H. J. McAdams office manager. The office for the north section is at Weatherford. R. M. Jones is superintendent and Joe Spillman office manager.

Work also is under way on three water crossings in Oklahoma for The Texas Pipe Line Company, the Ouachita River, Criner Creek, and Walnut Creek. Jack Landers is handling these jobs and working out of Fort Worth.

Fish Constructors, Inc., M. and M. Building, Houston, Texas, is acting as agents for construction of Transcontinental Gas Pipe Line Corporation's 2239-mile line from the Lower Rio Grande Valley of Texas to New York City. This year 612 miles of pipe will be laid by Morrison Construction Company, Wunderlich and Griffis Pipe Line Construction Company, Midwestern Constructors, Inc., and Williams Brothers Corporation. Five compressor stations also will be constructed this year, which work will be handled by the Fish organization. A total of 20 stations will be installed on the completed project.

Morrison Construction Company, Inc., P. O. Box 798, Austin, Texas, has been under way more than a month on the 90 miles of 30-in. high pressure gas line it is laying for Tennessee Gas Transmission Company in Tennessee and Kentucky. The 43 miles of 12-in. for the United States Atomic Energy Commission near Los Alamos, New Mexico, is approaching completion. Progress is being made on the 180 miles of 30-in. that is under construction for Transcontinental Gas Pipe Line between Bassfield, Mississippi, and Eunice, Louisiana.

R. H. Fulton and Company, P. O. Box 1542, Lubbock, Texas, announces the following work under way: 130 miles of 26-in. for Cities Service Gas Company between Newton and Ottawa, Kansas; 84.5 miles of 24 and 26-in. loops near Liberal, Kansas, for Panhandle Eastern Pipe Line Company; 62 miles of 20 and 24-in. near Garden City, Kansas, for Northern Natural Gas Company; 15.7 miles of 20-in. near Lakin, Kansas, for Colorado Interstate Gas Company; crossing of the Cimarron River for Panhandle Eastern; Arkansas River crossing for Colorado Interstate, and a river job in Iowa for Northern Natural.

J. R. Horrigan Construction Company, Commerce Building, Houston, Texas, has completed approximately two-thirds of the 110 miles of 26-in. it is laying for Texas Gas Transmission Corporation from Memphis, Tennessee, to Fulton, Kentucky. The field office has been moved from Memphis to Halls, Tennessee. W. H. Law is superintendent, Henry Cook spread foreman, Gene Gohring office manager, Joe Charon purchasing agent, N. L. Aire assistant spread foreman, Ned Swink assistant spread foreman, L. H. Rodgers timber foreman, Johnnie Strange right-of-way foreman, Claude Rodgers ditch foreman, Bill Causey stringing foreman, Otho Swink pipe foreman, K. E. Rodgers welding foreman, B. H. Tucker dope foreman, Gene Miller clean-up foreman, and "Gator" Lowery lowering-in foreman.

The company also is laying 340 miles of 24-in. and 260-miles of 22-in. for Michigan-Wisconsin Pipe Line Company from Nordaway County, Missouri, to Mecosta County, Michigan. Ben Law is general superintendent. Spread foreman are J. F. Flannagan, Louis Visentine, and M. E. Shifflet.

Bechtel-Price-Conyes, 220 Bush Street, San Francisco, California, is working near Hollister, California, on the Pacific Gas and Electric Company line that is being constructed between Topock, Arizona, and Milpitas, California. This is 506 miles of 34-in. pipe. The field office is at Paicines, California, and R. L. Bowman is the superintendent.

Bechtel-Conyes, 220 Bush Street, San Francisco, California, has completed the laying of 62 miles of 18-in. crude oil line for The Texas Empire Pipe Line Company between Wilmington, Illinois, and Gibson City.

N. A. Saigh Company, Inc., Suite 531, Majestic Building, San Antonio, Texas, began work August 1 on the multiple crossing it is making of the Mississippi River near Greenville, Mississippi, for Texas Gas Transmission Corporation. The crossing will consist of four 16-in. high pressure gas lines each approximately 15,000 ft long, extending from the land side of the east levee to the land side of the west levee. The company's field office is at 220 Main Street, Greenville. Carl Doyle is superintendent, James E. Gray office manager, Jax T. Holder welding foreman, and Orville Jenkins pipe foreman.

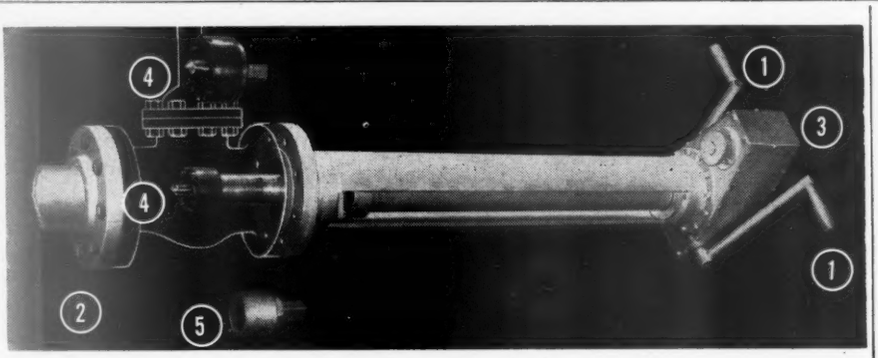
The contractor also will lay 103 miles of 20-in. for Texas Gas from Carthage, Texas, to Sharon, Louisiana, near Lisbon. Although this work is not yet under way it will be started in time to be completed by January 1.

Associated Pipe Line Contractors, Inc., P. O. Box 2163, Houston, Texas, was recently awarded a contract to lay 111 miles of 22-in. pipe for the Mid-Valley Pipeline Company from Mayersville, Mississippi, to a point near Oakland, Mississippi. Work is scheduled to begin in December.

This contractor also is laying 122 miles of 26-in. for Texas Eastern Transmission Corporation from Somerset to Lebanon, Ohio. J. A. Williamson is general superintendent, L. H. Gray spread foreman, A. B. Johnson office manager, James Luther timechecker, W. F. Van Cleave timekeeper, J. N. Lowrance purchasing. Homer Cotter pipe foreman, Keller Davis welding foreman, E. J. Reynolds right-of-way foreman, Brit Forse road crossing foreman, and Roy Connors ditch foreman.

Eastern Construction Company, 1801 Mercantile Bank Building, Dallas, Texas, will not begin work until in December on the sections it will construct of Mid-Valley Pipeline Company's crude oil system from Longview, Texas, to Lima, Ohio. Eastern will lay Sections 3-B and 4-A, 111 miles of 22-in., from a point near Oakland to Henderson, Tennessee, and sections 4-B and 5-A, 111 miles of 22-in., from Henderson to Clarksville, Tennessee.

Meanwhile the company has completed the 29-mile Nebraska loop for Northern Natural Gas Company and is working on a 17-mile loop in Iowa. The field office has been moved to Atlantic, Iowa. Yet to be laid is a 21-mile loop near Fremont, Nebraska. J. W. Arthur is general superintendent, Fred Ponder spread foreman, and Fred Harwell office manager.



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FEATURES—

2,000 p.s.i. test pressure.
Maximum tap: 6" standard (8" special).
Power: air motor or manual—dual cranks (1).
Flanged (or threaded) Tapping Nipple (2) welded to pipe line.

Automatic feed (3) protects shell cutters (4). Pilot Drill (4) holds "coupon" in shell cutter. Nipple Plug (5) permits removal of tapping valves . . . an exclusive feature.

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THE PIG WITH THE POKE CLEANS PIPE LINES

T. D. Williamson, Inc.
TULSA 9, OKLAHOMA

*Patent No. 2,097,398
Other Patents Pending

O. C. Whitaker Company, 804 Dan Waggoner Building, Fort Worth, Texas, has completed 60 miles (September 1) of the Texas Gas Transmission Corporation line between Greenville and Lula, Mississippi. The total distance is 86.17 miles. J. T. "Borger Red" McMenamy is spread foreman, Lee Price office manager, and Bob Carlton and Ed Pratt office assistants. The job foremen are: Roy Gould right-of-way, "Tex" Merida ditch, Floyd Lewis bending, Victor Kowaski pipe, "Slim" Williamson welding, Preston Howard prime, William Buzzard "dope," J. J. Walden lowering-in, and Billy Mayfield clean-up. The field office is at Cleveland, Mississippi.

Since pipe was received and actual laying got under way the latter part of July, the United Gas Pipe Line Company job from the Baxterville field, Mississippi, to Mobile, Alabama, has been making rapid progress. Approximately 65 miles had been laid to September 1. This is a 20-in. line. Jimmy Reid is superintendent and Pat Rogan office manager at Lumberton, Mississippi. Merle Tatom is superintendent and Earl Nevins office manager at Ludedale.

J. C. Minyard is general superintendent over both jobs.

Dumas Pipe Coating Company, P. O. Box 43, Dumas, Texas, is coating 14.6 miles of 24-in. pipe that is being laid in Sherman County, Texas, by Vaughn and Taylor Construction Company for Phillips Petroleum Company. L. B. Lingle is in charge.

Midwestern Constructors, Inc., 105 North Boulder, Tulsa, Oklahoma, is laying 80 miles of 26-in. gas line for Texas Gas Transmission Corporation from the Ohio River near Carrollton, Kentucky, to Middletown, Ohio. Work began July 18 in the hilly country of Jefferson County, Indiana. The field office is at 108½ East Main Street, Madison, Indiana. R. Carl Stanley is superintendent in charge and E. E. Haworth is managing the office. The company also is installing multiple 20-in. lines across the Green River near Slaughters, Kentucky, where the field office has been established. Leroy Jackson is the superintendent in charge of this work and Kenneth Regan is office manager.

Sections 4 and 5 are being laid for Transcontinental Gas Pipe Line Corporation (Fish Constructors, Inc., agent). The two sections consist of 216 miles of 30-in. between Demopolis, Alabama, and Newman, Georgia. Both sections are under the direction of M. T. (Bill) Wilhite. The field office for Section 4 is at Selma, Alabama, and A. T. Tolbert is manager. Section 5 field office at Newman, Georgia, with Richard Leonard assistant superintendent and Phil Whittaker office manager.

Midwestern is nearing completion of additions to the gas compressor station and dehydration plant it is making at Fritch, Texas, for Texoma Natural Gas Company. J. A. Baird is superintendent.

Williams Brothers Corporation, National Bank of Tulsa Building, Tulsa, Oklahoma, has completed approximately half of the 166 miles of 26-in. being laid for Texas Gas Transmission Corporation. The spread constructing the line from Slaughters to Brandenburg, Kentucky, is working out of Hardinsburg. Earl Taylor is superintendent. The second crew is laying pipe from Brandenburg to the Ohio River at a point near Carrollton, Kentucky. K. A. Owen is in charge of this spread and headquarters are at Shively, Kentucky, a suburb of Louisville. O. L. "Whitey" Martin is general superintendent over both spreads. Williams Brothers also are making the Ohio River crossing, installing four 16-in. lines near Carrollton. "Fats" McCartney is supervising the job. Work is getting under way on the Transcontinental Gas Pipe Line Corporation job in Georgia. A total of 112 miles will be laid between Newman and Danielsville.

Dunn Brothers (Stringing Contractors), 1420½ Wood Street, Dallas, Texas, have moved their field office from Lindsey to Clinton, Louisiana, as work progresses on the Transcontinental Gas Pipe Line Corporation line. The company is stringing 180 miles for Morrison Construction Company. H. E. Taylor is superintendent. In West Virginia and Maryland 200 miles of 26-in. is being strung for H. C. Price Company on the Virginia Gas Transmission Corporation and Atlantic Seaboard Corporation system. This work is about half completed (September 1). Headquarters are at Elkins, West Virginia, with H. G. Taylor in charge as superintendent.

A job just starting is for Oklahoma Contracting Company on the Salt Lake Pipe Line Company system. Between Burley and Boise, Idaho, 151 miles of 8-in. will be strung. An office has been opened at Burley, Idaho. Art Kane is superintendent. No stringing is being done for Lehman-Hoge and Scott on the job the latter is doing for Alabama-Tennesse Natural Gas Company, the contractor being out of pipe. This is 82 miles of 10-in. from Selmer, Tennessee, to Florence, Alabama.

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PIPE LINE PROJECTS

Great Lakes to Spend $37,500,000 Immediately

Following the recent announcement by Great Lakes Pipe Line Company of the private sale of $55,000,000 of 20-year sinking fund debentures to institutional investors, it was disclosed by Harry Moreland, president of the company, that an immediate expenditure of $37,500,000 will be made in an expansion program aimed at giving Great Lakes increased system capacity by the middle of the approaching heating season.

Included in the project is construction of 931 miles of 12-in. line along existing routes from Ponca City and Tulsa, Oklahoma, through Kansas City, Kansas, Des Moines and Mason City, Iowa, to Minneapolis, Minnesota, and from Kansas City to Omaha, Nebraska, and a 45-mile 8-in. line from Cushing through Drumright to Tulsa. Twelve pump stations and six delivery terminals will be enlarged.

The first section of the 12-in. line of Great Lakes will be laid between Des Moines and Minneapolis, and is expected to be completed by December 15. Completion of this section will increase system capacity 200,000 bbl a month to Minneapolis.

While this section is being laid, work will go forward on construction of the 12-in. line from Des Moines southward to Ponca City and Tulsa; the 8-in. line from Cushing through Drumright to Tulsa; larger connecting lines at refineries; enlargement of facilities at main line pump stations, and expansion of terminals.

Plans call for the enlargement of pump stations at Cushing, Tulsa, Drumright, Ponca City, and Barnsdall, Oklahoma; Humboldt and Kansas City, Kansas; Ridgeway, Missouri; Des Moines and Latimer, Iowa; Faribault, Minnesota, and Falls City, Nebraska.

Terminal tankage, piping and motor transport loading facilities will be expanded at Kansas City: Des Moines and Mason City, Iowa; Mankato and Minneapolis, Minnesota, and Omaha, Nebraska.

As lines will be completed in advance of permanent pumping facilities, temporary pumping units will be installed. With these in operation on the new lines, a total monthly system improvement of 1,000,000 bbl will become available February 1, 1950.

Delivery of the 12-in. pipe for the Kansas City-Omaha section is expected to be made during the first quarter of 1950. It will be stockpiled so that construction can begin as soon as possible next spring to provide additional capacity to transport gasoline into Nebraska, western Iowa and Minnesota, and the Dakotas to meet the heavy demand of farming operations.

Construction on pump stations and terminals will be carried on as rapidly as possible but because of the complex nature of the work it is not scheduled to be completed before the summer of 1950. When the program is finished, the company expects to be transporting 50,000,000 bbl of products a year.

Shell Line Planned To Serve Elk City Field

Plans for the construction of a 10-in. pipe line to extend from the Elk City oil field in Beckham County, Oklahoma, to Cushing, Oklahoma, a distance of approximately 160 miles, were announced by T. E. Swigart, president, Shell Pipe Line Corporation. It was also revealed that the recently discovered Elk City field, which will be served by the new line, is one of the most important oil field developments in Oklahoma in recent years, with production expected to reach 11,000 bbl a day by the time the line is completed and in operation.

The new pipe line will be built at an estimated cost of approximately $4,000,000 and have an initial capacity of 24,000 bbl a day. With the construction of intermediate pump stations, as oil production increases, the line will have an ultimate capacity of 50,000 bbl a day. At Cushing the new project will tie in with the now-completed 22-in., 1000-mile Basin-Ozark Pipe Line System, which transports crude oil from Jal, New Mexico, through Cushing, to Wood River, Illinois.

Swigart stated that the Basin-Ozark Line replaces one of Shell Pipe Line's existing 10-in. lines from Cushing to Wood River, thus making it possible to utilize reconditioned pipe from the latter line in the construction of the new Elk City-Cushing project.

TGT Wants to Expand Into New England Area

The Tennessee Gas Transmission Company has filed an application with the Federal Power Commission in Washington seeking authority to extend its natural gas pipe line system to New England. The company asked for a certificate of public convenience and necessity authorizing an increase in the daily capacity of the system to 1,260,000,000 cu ft. The extension and expansion sought would cost an estimated $94,000,000.

When completed into New England, the Tennessee Gas Transmission Company's system would be approximately 2142 miles long, 1759 miles of which already have been authorized by the Federal Power Commission.

The latest in a long series of moves first inaugurated by the company in October of 1947 to bring natural gas into New England was announced by Gardiner Symonds, company president. Tennessee Gas has been steadily building up its pipe line system to serve New England since that time and only four days prior to the latest application had received a FPC certificate of public convenience and necessity to extend its main transmission line from Morehead, Kentucky, near the present terminus, to a point near Buffalo, New York.

The company now would extend the system from the authorized temporary terminus near Buffalo to Worcester, Massachusetts, a distance of 383 miles, from which terminus all six New England states can be served.

The latest application, in addition to asking authority to construct the 383 miles of 26-in. pipe, also asked authority to construct 543 miles of 24, 26, and 30-in. loop lines paralleling the existing main transmission line, to construct four new compressor stations totaling 34,000 hp, and to enlarge existing compressor stations by 51,200 hp.

The company now is expanding the existing system to raise the daily capacity from the present 615,000,000 cu ft to 831,000,000 cu ft and will immediately start on the expansion program authorized by the FPC to raise the daily capacity to 1,060,000,000 cu ft. This includes the 395-mile extension to Buffalo.

Low Footage Cost
OF APPLYING NO-OX-ID PROTECTION
Achieved with This Fast-Moving Equipment

Because of the speed with which the traveling machine applies NO-OX-ID materials to pipe lines, the footage cost of NO-OX-ID protection is substantially reduced.

The compact, self-propelled unit rides the pipe and moves at a rapid rate, applying both coating and wrapper simultaneously, without the lost motions incident to manual applications. The pipe is cradled into the ditch immediately behind the coating machine. Illustration shows the unit making a hot application of NO-OX-ID 6X and wrapping the pipe with No. 7 NO-OX-IDized reinforced asbestos wrapper.

NO-OX-ID coatings contain chemical inhibitors, bond firmly, seal out all rust-forming moisture. Wrappers, also chemically impregnated and water repellent, aid in maintaining the coating's firm bond, reduce abrasion and soil attachment. All NO-OX-ID materials are nontoxic, cause no aggravating skin reactions.

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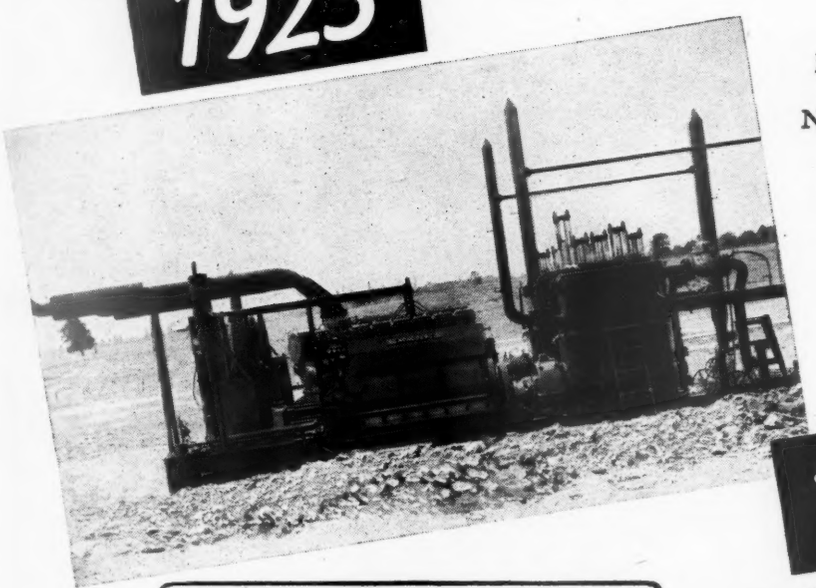
Shown at the left are two 375 h.p. Nordberg four-cycle Supercharged Diesels operating pipe line pumps.



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United Gas Seeks Two FPC Permits

United Gas Pipe Line Company has applied to the Federal Power Commission for authorization to build 224 miles of pipe line designed to carry natural gas from several producing fields in southeastern Louisiana for delivery to Atlantic Gulf Gas Company at the western terminus of that company's proposed Louisiana-South Carolina-Florida pipe line project.

United's proposed project, to be built at an estimated cost of $25,060,000, would deliver the requirements of the proposed Atlantic Gulf line, estimated at 384,251,000 cu ft of natural gas per day for the fifth year of operation.

Atlantic recently filed an amended application in connection with its proposed line, and hearings are now in progress in Washington, D. C. The Atlantic project, as now proposed, involves 1731 miles of pipe line from eastern Louisiana across Mississippi, Alabama, and into Georgia, where it would fork out with one line extending northeast to Georgetown, South Carolina, and the other southeast to Jacksonville, Florida. Estimated cost of this construction is $92,000,000.

Both companies are subsidiaries of United Gas Corporation and have main offices in Shreveport, Louisiana.

United Gas Pipe Line Company also has asked FPC to authorize construction of 105.6 miles of loop line in Louisiana designed to increase the company's deliveries of natural gas to Mississippi River Fuel Corporation to approximately 195,000,000 cu ft daily.

The proposed 20-in. loop line would parallel United's existing 24-in. Carthage (Texas)-Sterlington (Louisiana) pipe line for part of its length in Louisiana only and would extend from DeSoto County, near the Texas-Louisiana state line east to a point in Ouachita Parish, near the city of Monroe, Louisiana.

Line Authorized

The Federal Power Commission has authorized Kansas-Nebraska Natural Gas Company, Inc., of Phillipsburg, Kansas, to construct additional natural gas transmission facilities, which will increase the capacity of the company's system to 140,000,000 cu ft of gas per day. Estimated cost of the construction is $2,339,457.

The company was authorized to construct 14 town-border measuring stations and approximately 301 miles of main, lateral, and loop lines, and to install new gas compressors with a total of 3600 hp in existing compressor stations.

Michigan-Wisconsin Line Gets Additional Permit

The Federal Power Commission has authorized Michigan-Wisconsin Pipe Line Company and Michigan Consolidated Gas Company, both of Detroit, Michigan, to construct additional natural gas facilities, which, among other things, will increase the capacity of Michigan-Wisconsin's Texas-to-Michigan pipe line project, now under construction, by 27,000,000 cu ft a day to a total of 155,000,000 cu ft.

Michigan-Wisconsin facilities authorized by FPC include substations of 24-in. pipe for the 26-in. pipe previously authorized between Hugoton field in Texas and the "Wisconsin Junction" near Millbrook, Illinois; and installation of compressor units that would increase the compressor horsepower from 15,600 to 21,600.

Michigan Consolidated, which will receive from Michigan-Wisconsin natural gas requirements in excess of those supplied to it under contract by Panhandle Eastern Pipe Line Company, was authorized to construct additional facilities in the storage fields, pipe lines for distribution of gas in its market area, and appurtenant facilities.

Northern Natural Is Adding Compressor Units

The Northern Natural Gas Company has five major compressor projects under way at the present time. At Palmyra a 1600-hp Worthington compressor unit is being added to the station. Si Schaulis is resident engineer on the job. The Fluor Corporation, Ltd., Los Angeles, is doing the construction. Completion is scheduled for October 5. Fluor also is installing a 1600-hp Cooper-Bessemer unit at Clifton station. This job is expected to be completed October 19. Dewey Rice is the resident engineer.

At Sublette station two 1600-hp Cooper-Bessemer units are being added, and the work should be completed by October 13. The Foor Construction Company of Oklahoma City is the contractor. Melvin Floyd is resident engineer for Northern Natural.

The Dresser Engineering Company of Tulsa is installing two new compressors at the Mullinville station. These are 1600-hp Cooper-Bessemer units and the work should be finished about September 15. Howard Spear is resident engineer.

At Bushton station one 1600-hp Worthington compressor unit is being added, completion being set for November 11. Dresser Engineering also is the contractor on this job. Elmer Gardner is resident engineer.

418
MILES
By One Spread in One Year

One pipeline spread of Latex Construction Company laid and took-up 418 miles of pipe during our fiscal year ending Nov. 30, 1948 . . . demonstrating the value of combining years of experience and specialization with a well integrated organization for more efficient pipeline construction.

The mileage of pipeline work done by this one spread was divided as follows:
Miles of Pipe laid, 16" and larger 306
Miles of Pipe laid, 8", 10" and 12" . . . 62
Miles of Pipe taken-up and reconditioned . . 50

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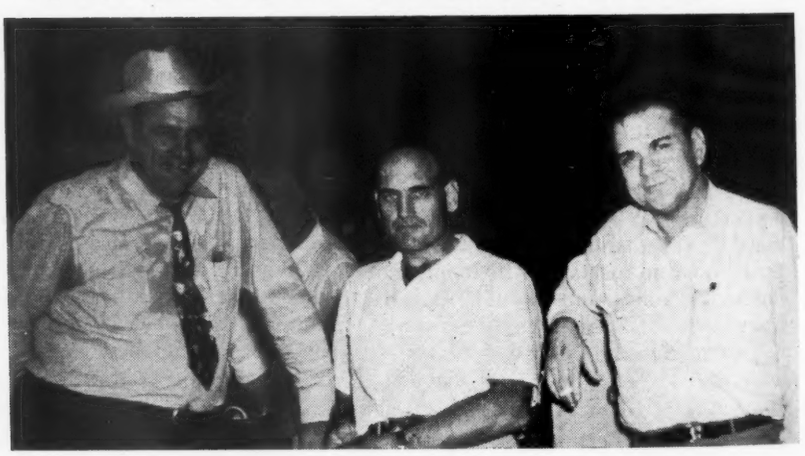
Betty Ross Breeland; Jack Breeland, Lone Star Gas Company; Mrs. N. W. Staples; Mrs. H. F. Stevens; Mrs. Jack Breeland; Mrs. Bill Campbell; Mrs. C. L. Young; "Hobby" Dunn; Mrs. Luther Tolbert; C. L. Young, Master Tank and Welding, and Luther Tolbert, Lone Star Gas.

Left, Mrs. Carl H. Dunn, Fort Worth, Norman Dunn and Carl Dunn.

E. D. Clutter, general superintendent, Manufacturers Light and Heat Company, Pittsburgh; Roy Clark, partner, Britton Contracting Co., Washington, Pennsylvania.

A group of Magnolia Pipe Line men. D. E. White, superintendent of maintenance; Stanley Westlake, assistant chief mechanical engineer; J. G. Norton, chief mechanical engineer; Jim Mathews, engineer, and D. D. Standlee, assistant to the manager.

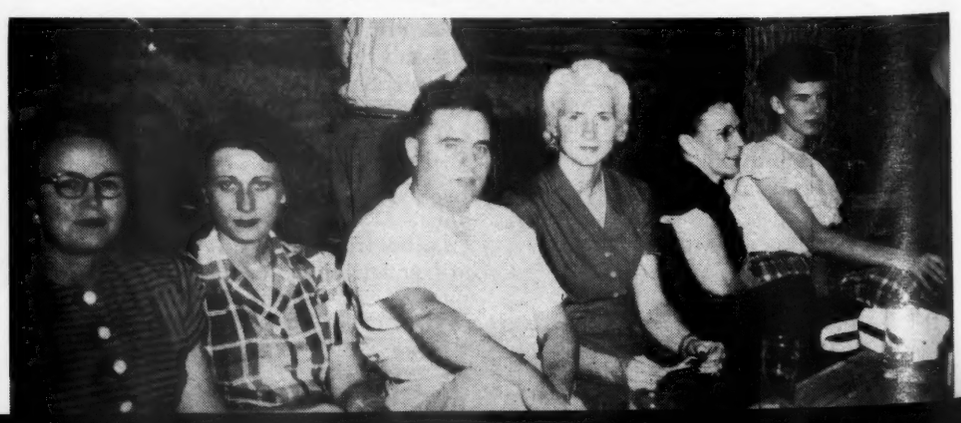
Teddie True, son of L. H. True of Magnolia Pipe Line Company; Eddie Morrill, son of Ed Morrill of Mid-Valley Pipeline Company, and Carey Crutcher, son of A. S. Crutcher of C-R-C.



J. P. Jackson, superintendent, Michigan-Wisconsin Pipe Line Company; Charles Coates, vice president and general superintendent, Tennessee Gas Transmission Company; Ellis Dunn, Dunn Brothers.

Tom Burk, engineer, Tennessee Gas Transmission Company, was sitting solid enough here.

Mrs. J. C. Britton, Clara tyles, Ed Morrill, vice president of Mid-Valley Pipeline Company, Mrs. Morrill, Mrs. "Buck" Fox and Mrs. Marshall Stalls.



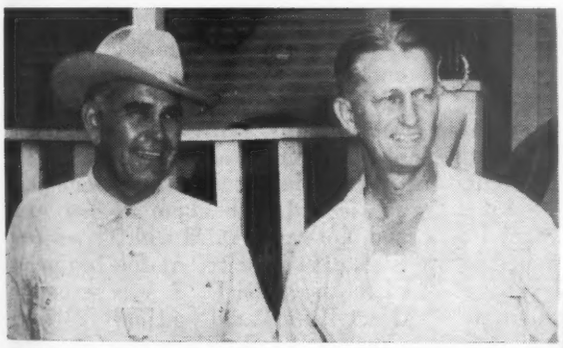
PICTORIAL

Twenty years ago the "Dunn Boys" gave the first of the annual parties that commemorate jointly the Golden Wedding Anniversary of their parents, the Allen Dunn's, and their father's birthday. The party, held at "Hobby" Dunn's D-Bar ranch, was on July 30 and 31 this year.

Dunn family group: C. Hobson "Hobby" Dunn, Clay Dunn, Norman Dunn, Mrs. Minnie Harris, Carl Dunn, Carmen McNeill ("Hobby's" daughter), Merlin Harris, Ellis Dunn, and the father, Allen "Dad" Dunn, seated.

J. C. Britton, Britton Contracting Company, Washington, Pennsylvania; A. S. Crutcher, Crutcher-Rolfs-Cummings, Inc., Houston, and I. C. Little, Dallas contractor, who recently came out of retirement.

G. O. Glandon, Midwestern Engine and Equipment Co., Tulsa, Oklahoma; E. D. Morris, Crutcher-Rolfs-Cummings, Inc., Houston, Texas; C. E. Hatcher, Crutcher-Rolfs-Cummings, Inc., Houston; R. F. Trapp, Midwestern Engine and Equipment Co., Tulsa; O. E. "Ted" Murrey, president, Midwestern Engine and Equipment Company, Tulsa; R. B. Dieter, G. G. Griffis Construction Company, Tulsa.



C. Hobson "Hobby" Dunn, president Eastern Construction Company, Dallas, Texas, and J. P. Bristow, executive vice president, Tennessee Gas Transmission Company, Houston, Texas.

T. S. "Ham" Bacon, chief engineer, Lone Star Gas Company, Dallas, Texas, Mrs. Bacon, their three children, and "Hobby" Dunn.

Gulf Pipe Line was represented. Mrs. Allen Walker; Harry Newnan, chief clerk, Fort Worth; Jack Johnson, special clerk; Mrs. J. J. Thorp; J. J. Thorp, West Texas district superintendent, and Allen Walker, district clerk.

MARINE OPERATIONS

Tankers Form 37.5 Per Cent Of Shipyard Construction

The growing proportion of tankers to dry cargo and passenger ships under construction in the shipyards throughout the world continues to be evidenced by reports from the various builders. According to Lloyd's Register statistics for the June quarter recently released, 37.5 per cent of ships building throughout the world are tankers.

To date no great attempt has been made to indicate the broad effect on the specialized methods adopted in tanker construction on other forms of shipbuilding, and it is only within a recent period that the size of tankers has grown large enough for this type of construction to interest shipbuilders who have previously built larger passenger and dry cargo ships.

Gulf Intracoastal Waterway Extended

"With the opening of the Corpus Christi to Brownsville, Texas, extension of the Gulf Intracoastal waterway, on the Rio Grande, a deep navigation inland waterway connecting Mexico, the United States, and Canada, and extending to Minneapolis-St. Paul and to Carrabelle, Florida, becomes a reality."

This was the statement by Chester C. Thompson, president of American Waterways Operators, a national association of the barge and towing vessels industry. He added:

"Now after 250 years of use of the Mississippi system by the white man, the inland canals, completed by U. S. Army Engineers and private contractors, have linked by inland waterway the three great nations of North America. Think of what this means to commerce of the nations, and in an emergency, what it would mean for mutual defense.

"The Gulf Intracoastal waterway now extends 1308 miles. There is also a Mexican government project under consideration which would extend the canal for many miles along that country's east coast.

"Just recently work also began on a ships canal from Galveston to Fort Worth and Dallas, Texas, the famed Trinity canal project, long contemplated. Completion of this project would give a waterway to north Texas and its big cities in that area, down to the Gulf and to all ports on the Intracoastal canal.

"Another canal across Florida from Carrabelle on the west coast to connect the Intracoastal link from the east coast of Florida all the way north to Boston is also projected."

Chevron Moves 4,500,000 Barrels of Oil in 3 Years

The motor tanker *Chevron* of 4039 deadweight tons, owned by the Standard Oil Company of California, has moved more than 4,500,000 bbl of oil since she was acquired by her owners in 1946. To accomplish this the vessel has been kept on the move steadily during the last three years and in that time has completed 153 voyages for a total of 138,000 miles. Designed by Joslyn and Ryan, San Francisco naval architects, *Chevron* conforms to the general specifications of the U. S. Maritime Commission's T1-M-BT2. Actually 20 of these type tankers were built toward the close of the war and propelled by Nordberg 2-cycle marine diesel engines.

Motor Tanker Vikland Has New Features

Speaking at the launching of the single-crew motor tanker *Vikland*. J. M. McNeill, managing director of John Brown and Company, Ltd., Clydebank, recently remarked that *Vikland* was the fifth and largest tanker launched at Clydebank. One of two vessels on order for the Tanker Corporation of Panama, *Vikland* has a deadweight capacity of 18,000 tons and a designed service speed of 14 knots, and her construction is reported to have incorporated several new features in prefabricated building. The building of the tanker has initiated many novel features of construction by prefabrication under cover of large constructional units.

Sweden Ranks Third In Tanker Construction

Next to Great Britain, which is building 70 tankers aggregating 695,210 gross tons, of which 58 are motorships of 579,840 gross tons, and the United States building 26 tankers of 432,940 gross tons, Sweden is currently the largest builder of tankers in the world, having 16 motor vessels of 142,970 gross tons on the stocks. Thus activities of Swedish builders in oil tanker construction reflect the present trend on the part of many nations towards self-sufficiency in the carriage of their oil supplies. At the same time, it is reported the Turkish Government has prepared a three-year development program including the purchase of two 10,000 dwt tankers from European yards.

U. S. Has 41 Per Cent Of Tanker Tonnage

An analysis of world tanker fleets as prepared by Benedict Saurino, manager, statistical research division, the Sun Oil Company, was recently released. Positionally, there has been a considerable change in the proportions of world tankers registered under various flags, Saurino points out. At present the United States is first with slightly more than 41 per cent of the world tonnage, whereas the United Kingdom and the Dominions are second with about 21 per cent, and Norway is third with 11 per cent of world capacity. At the beginning of the war, the U. S. was second to Great Britain and had only 23.9 per cent of the world's tanker capacity, while Britain had more than 28 per cent, Norway being third with 19.5 per cent. Thus the U. S. has gained a positional increase of 72 per cent, while the U. K. indicates a loss of 25 per cent in world fleet position, and the Norwegian flag has lost nearly one-half of the positional advantage it enjoyed prewar.

On a world-wide basis, the current construction program represents more than one-third of today's fleet. The 436 T-2 type equivalents under construction or under order at present represent 90 per cent of the tonnage built in the two highest years of world tanker construction, namely 1943 and 1944. With approximate delivery dates terminating by the end of 1952, it develops that in 1949 and 1950, more than 238 T-2 type equivalents of this entire program will be delivered and in service. In calculating the effect upon the world picture during the next four years, a range has been established showing the possible limits of these additions.

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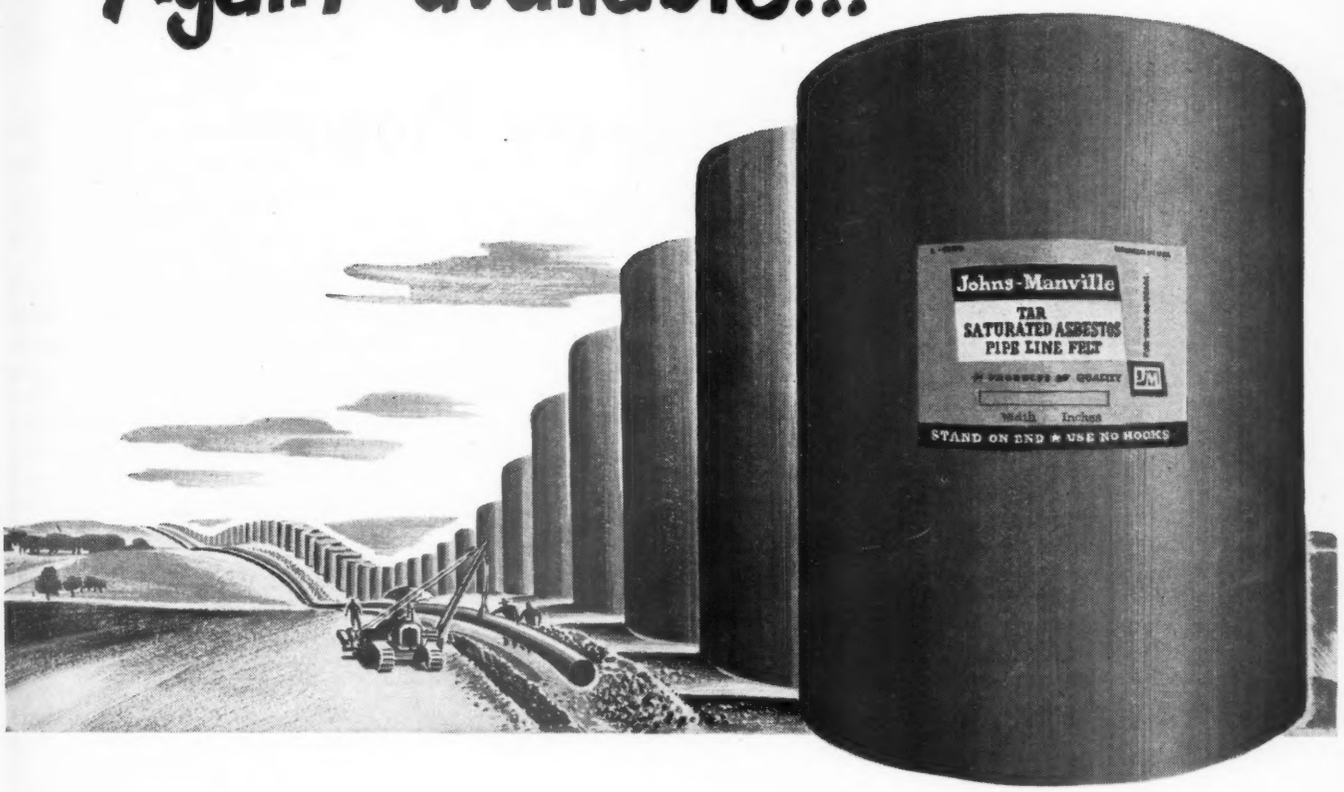

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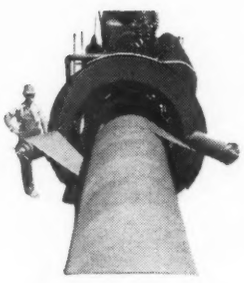

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Petroleum Equipment and the European Recovery Program

SUMMARY

Petroleum Equipment

The Importance of the Program to European Recovery. The provision of adequate supplies of petroleum products for essential economic activities was the most urgent and immediate petroleum problem during the early stages of the European Recovery Program. However, the provision of equipment to make possible the sound and economic development of the petroleum industry will be a most essential contribution in helping Europe achieve economic recovery and in making Europe ultimately independent of extraordinary outside assistance. Basically, the petroleum equipment program of the participating countries can be divided into two separate but closely integrated parts:

1. The program for the expansion of refining facilities both within the participating countries by all companies and outside Europe by companies of the participating countries; and

2. The program for increasing crude oil production outside Europe by companies of the participating countries, mainly the United Kingdom, the Netherlands and, to a lesser extent, France.

There are probably very few other industries which will yield as high a rate of return per unit of investment of dollars and of scarce resources—steel, machinery, and manpower—as the petroleum industry.[8]

The Value and the Extent of the Equipment Program. In the national submissions it is estimated that petroleum equipment valued at $592,000,000 will be required in fiscal 1950 of which $211,000,000 worth will come from dollar sources, that is, almost exclusively from the United States. The report submitted by OEEC for fiscal 1949 estimated that equipment valued at $573,000,000 would be required, of which $192,000,000 worth was expected to come from the United States.[9]

The petroleum equipment programs for fiscal 1949 and fiscal 1950 can be evaluated only against the long-term program of which they are a part. The individual countries have presented long-term programs which would result in an over-all increase in annual refining capacity in Europe from 20,400,000 tons at the end of 1947 to 65,700,000 tons in fiscal 1953, and an increase outside Europe from 49,700,000 tons at the end of 1947 to 72,000,000 tons in fiscal 1953. Crude oil production, nearly exclusively overseas, according to the individual programs would increase from 55,000,000 tons in 1947 to 116,000,000 tons in fiscal 1953.

To be fully effective and economically justified, the whole program must fit into the framework of the international oil economy and be coordinated with the domestic and overseas non-European operations of the American oil industry, which are closely related all over the world to the operations of the British, Dutch, and French oil industries in a very complex and intricate manner. Whether Europe's oil-development program is realistic and will yield the desired results in terms of European recovery, rather than lead to an unnecessary duplication of existing facilities and to a disruption of Europe's oil economy, as well as that of the rest of the world, depends on such a coordination. Therefore the plans for Europe's expansion can be judged only in terms of an analysis of world oil economics. It is too early to arrive at a definite conclusion on the development program as submitted to the OEEC, but the guiding considerations and principles that have to be applied are clear enough to be stated at this time.

In reasons outlined in detail in the following sections of this report, it appears that the long-term program is too ambitiously estimated and that, as a result, the program figures submitted will be reduced. Therefore, the fiscal 1949 and 1950 programs, insofar as they are an integral part of the long-term program, must also be adjusted, although the effect of the cut in the long-term program probably may not be fully reflected in these programs.

An additional important element must be considered when examining the effect of the petroleum program on the balance-of-payment positions of the participating countries. As mentioned before, the national programs include equipment from dollar sources required by American companies operating in Europe, and outside Europe in partnership with British companies, necessarily so because it too must come from the United States and will be a factor in evaluating the impact

NOTE: Footnotes 1-7 will be found in earlier article on ERP as it pertained to petroleum, *The Petroleum Engineer*, August, 1949, page A-39.

8. However, investment in petroleum refining may not be equally advantageous for all countries because of the relatively large amount of capital and the relatively small amount of labor required.

9. In general, these estimates include the equipment required by American companies operating within the participating countries and jointly with British companies overseas.

Foreword

This document is based on the best information regarding petroleum* and petroleum equipment currently available to the Economic Cooperation Administration, and the views expressed herein are the considered judgment of the Administration. Both the text and the figures for 1949-50 are still preliminary in character; participating countries will therefore understand that this report cannot be used to support any request, either to the Organization for European Economic Cooperation or to the Economic Cooperation Administration, for aid in any particular amount for any country or for any particular purchase or payment.

(Signed) PAUL G. HOFFMAN.

**The story of ERP petroleum was carried in the August, 1949, issue of The Petroleum Engineer, Page A-39.*

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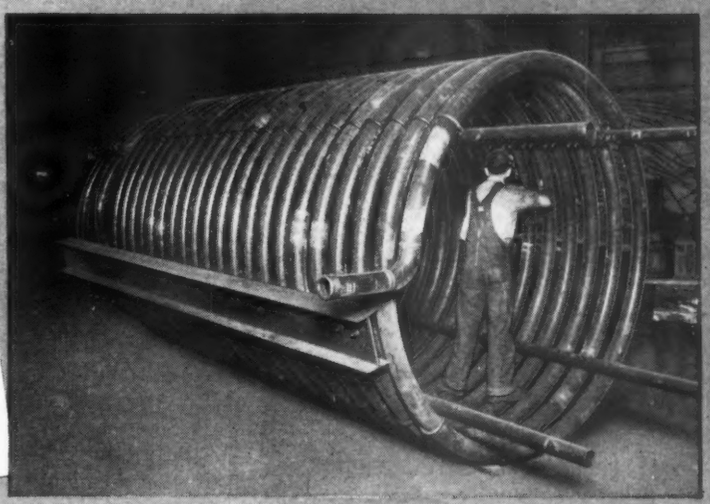
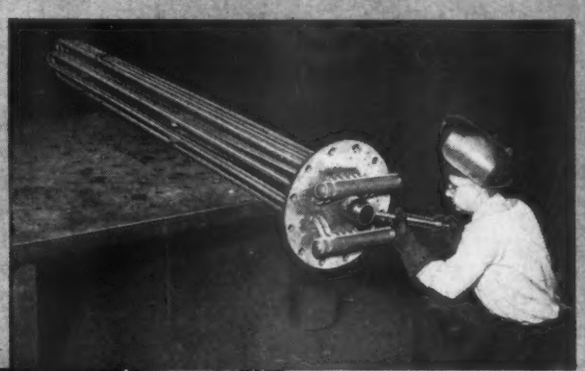
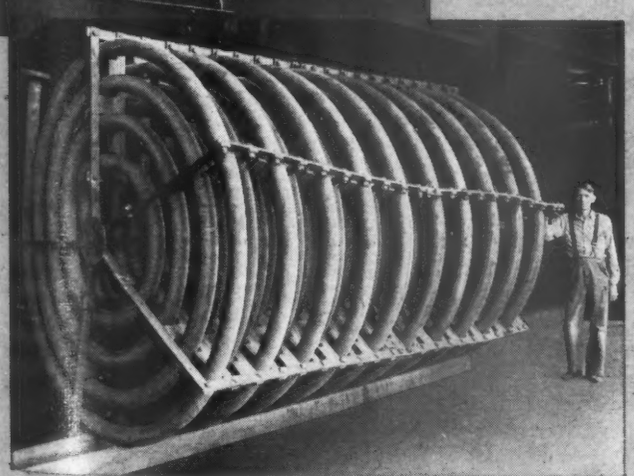


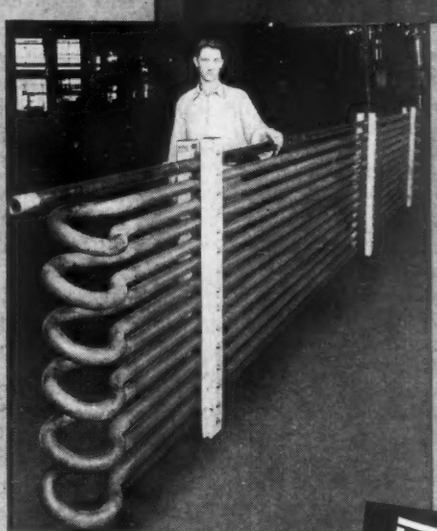
Cylindrical end of polymerization heater coil approximately 8 ft in diameter and containing 850 ft of 4" standard Grade "A" seamless steel pipe.

A nest of box coils containing 850 ft of 2" extra strong seamless pipe, to be used as storage tank heater.



Catalytic reactor coil consisting of 20 flat spirals of 4½" OD x ¼" wall 4-6% chrome, ½% moly seamless pipe. Full-furnace annealing distorted temporary shipping straps.





Nested hairpin coil used as unit heater in 14" diam tank; made from 300 ft of ¾" OD x #14 BWG seamless boiler tubing.

Condenser coil fabricated from 2" OD x ⅜" wall seamless steel pipe. Coil was tested to 7500 psi and is 26 ft long.

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of the program on the domestic economy.

However, although the value of equipment imported from dollar sources by subsidiaries of American companies to the extent that it will be financed by new dollar investments of their parent companies is also part of the European equipment program, it obviously does not have to be financed out of European dollar income and will not require ECA aid. Accordingly, neither the dollars spent for such imports of petroleum equipment nor the corresponding new investment made by American companies is shown in the balance of payments for fiscal 1950. After allowing for a reduction in the petroleum equipment program as suggested in this report and for new dollar investments of American companies, ECA estimates, on a provisional and highly tentative basis, that somewhat over $100,000,000[10] of equipment imports will have to be financed from European dollar resources or by ECA aid.

PETROLEUM EQUIPMENT

The Importance of the Program to European Recovery

The sound and economic development of the petroleum industry of the participating countries is a most essential part of the European Recovery Program. Basically, the program consists of two separate but closely integrated divisions:

1. The program for the expansion of refining facilities within the participating countries and outside Europe by companies of the participating countries: and

2. The program for increasing crude-oil production outside Europe by companies of the participating countries.

There are probably very few other industries which will yield as high a rate of return per unit of investment of dollars and of scarce resources—steel, machinery, and manpower—as the petroleum industry.[18] A few key figures will illustrate the importance of the program to European recovery.

The construction of even a simple refining unit to process Middle East crude oil will enable an European country to import lower-priced crude oil instead of higher-priced products and save in foreign exchange from 20 to 25 per cent of the value of imported refined products.[19] In addition, a refining unit in an European country will provide an important basis for chemical and other byproduct industries.

The expansion of crude oil production and refining capacity outside Europe by companies of participating countries[20] will provide a most important source of foreign exchange income. The present British program, if carried out, would result by fiscal 1953, according to British estimates, at present prices and exchange rates, in an increase over 1948 of approximately one billion dollars[21] annually in the value of crude oil and refined products output. This would be achieved with an estimated expenditure for equipment, including maintenance, repairs, and operational supplies (MRO) (including total new investment and MRO) equivalent to one and a half to two billion dollars; of this amount approximately 30 per cent would be dollar expenditures. Similarly, France estimates that, for each million tons of increased crude oil production available through its 23.75 per cent interest in the Iraq Petroleum Company, the French economy will save the equivalent of from $8,000,000 to $10,000,000 in foreign exchange, of which 60 per cent would be dollars.

The Program for the Expansion of Refining Facilities

The European countries have prepared for OEEC a refining program to be carried out during the recovery period. The OEEC has not yet analyzed and evaluated the long-term

10. A more definitive figure can be established by ECA only after the OEEC's Oil Committee has completed its analysis and evaluation of the equipment programs of the participating countries.

Footnotes 11 to 17 are in "Petroleum and European Recovery Program," *The Petroleum Engineer*, August, 1949.

18. However, petroleum refining requires a relatively large use of capital and a relatively small use of labor. Under these conditions the value of capital investments in petroleum refining, as contrasted with alternative investments in other industries employing more workers per million dollars of investment, should also be carefully considered. The capital-intensive character of petroleum refining means that the development of the refining industry may not be equally advantageous in all countries.

19. Calculated on the basis of November 1948 prices. By the end of March 1949, prices of most products had declined without a corresponding decline in crude oil prices. The savings made possible by home refining will, of course, depend on the relation between the prices of crude oil and of refined products.

20. In this connection, it is noteworthy that proved reserves of the two largest British and British-Dutch oil companies, the Anglo-Iranian Oil Company and the Royal Dutch Shell Group, have been estimated in the December 1948 issue of "World Oil" at about 13.6 billion barrels or nearly 21 per cent of total world proved reserves whereas their production in 1948 accounted for less than 15 per cent of the world total. Their total production in 1948 was only 3.5 per cent of their proved reserves compared to the United States where 1948 production was at a rate equal to more than 9 per cent of proved reserves.

21. Only part of the increased value, of course, would result in a higher foreign exchange income to the British economy.

program figures included but it is presently engaged in such a study. Data on past, present, and planned future refining capacity in Europe of all companies and on the refining capacity outside Europe of companies of the participating countries, as presented to the OEEC, are summarized in table J.

TABLE J. Estimated refining capacity in participating countries and of companies of participating countries overseas[1] (national submissions).

(In millions of metric tons)

	Europe	Overseas	Total
1947.....	20.4	49.7	70.1
Fiscal 1949.....	27.5	54.2	81.7
Fiscal 1950.....	35.2	57.0	92.2
Fiscal 1953.....	65.7	72.0	[2] 137.7

[1] Includes capacity of subsidiaries of American companies in Europe only; excludes all capacity of companies of participating countries in North America..

[2] According to present plans included in the national submissions, total capacity will increase to 153 million tons by fiscal 1955.

Note.—Data for some countries represent estimated throughput and for some countries estimated capacity.

European refining capacity, according to the data prepared for OEEC by the individual countries, will have increased from about 19,300,000 tons in 1938 to 27,500,000 tons in fiscal 1949. The expansion of capacity since the end of the war is particularly impressive in view of the destruction suffered by the industry during the war. Part of the expansion of output, however, was obtained by increasing the yield of heavy products at the expense of light products which permitted an increase in throughput with relatively little new equipment. It is clear that the future program must provide not only for an increased volume but also for a higher quality of products. Accordingly, the European countries are planning to increase the output of quality gasoline, of lubricating oils and of specialty products requiring complicated equipment for which American technical know-how is indispensable.

By fiscal 1950, European refining capacity is expected to reach 35,200,000 tons and, by fiscal 1953, the estimates of the European countries show a planned capacity of 65,700,000 tons. This is a remarkable increase, particularly in comparison with the refining capacity estimates included in the original CEEC report of about 35,000,000 tons for the end of 1951, the last year for which CEEC estimates were made. Prospective refining capacity in Europe in fiscal 1953 as planned by the individual countries would, therefore, exceed their estimated 1953 domestic demand of 62,400,000 tons.[22]

Without going into a country-by-country discussion, it should be pointed out here that the over-all program which would result from adding together the individual country submissions appears to be too high. It must be emphasized strongly that none but economically sound projects, judged separately and in combination, should be included in the long-term program. In this connection it should be pointed out that some of the countries by fiscal 1953 expect to supply not only their total domestic needs from the output of domestic refineries but also to export refined products to neighboring, or even to more distant, countries. At the same time, such neighboring countries appear to be making plans to cover their own needs and frequently also to supply an exportable surplus from domestic refinery production.

As a result, when the individual country plans are added together, the total European import-refining-consumption-export picture for fiscal 1953 does not represent a well-balanced oil economy. Based on these plans, Europe in fiscal 1953 would have available 59,600,000 tons of

22. Estimated by ECA at 58,000,000 to 60,000,000 tons.

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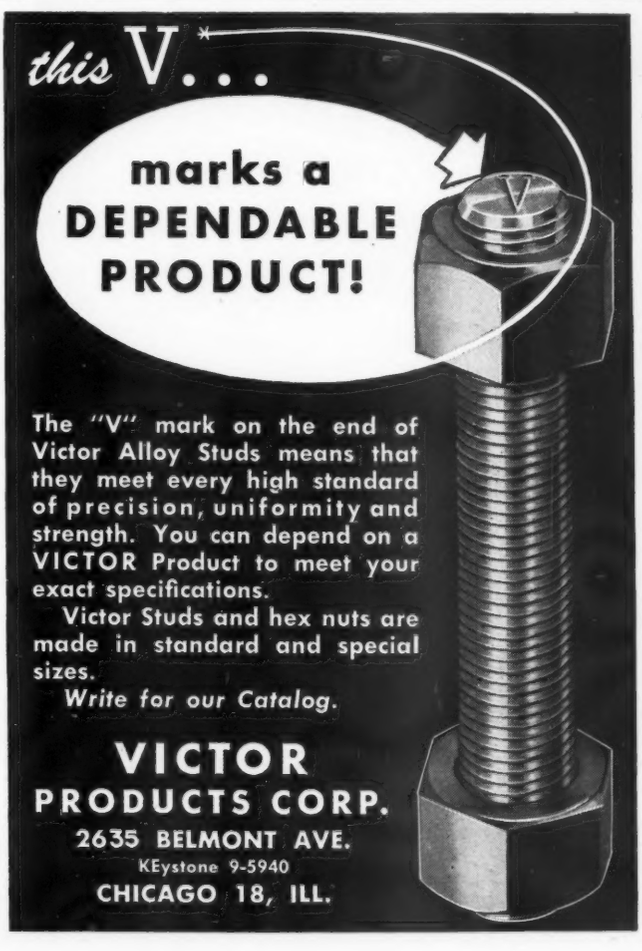
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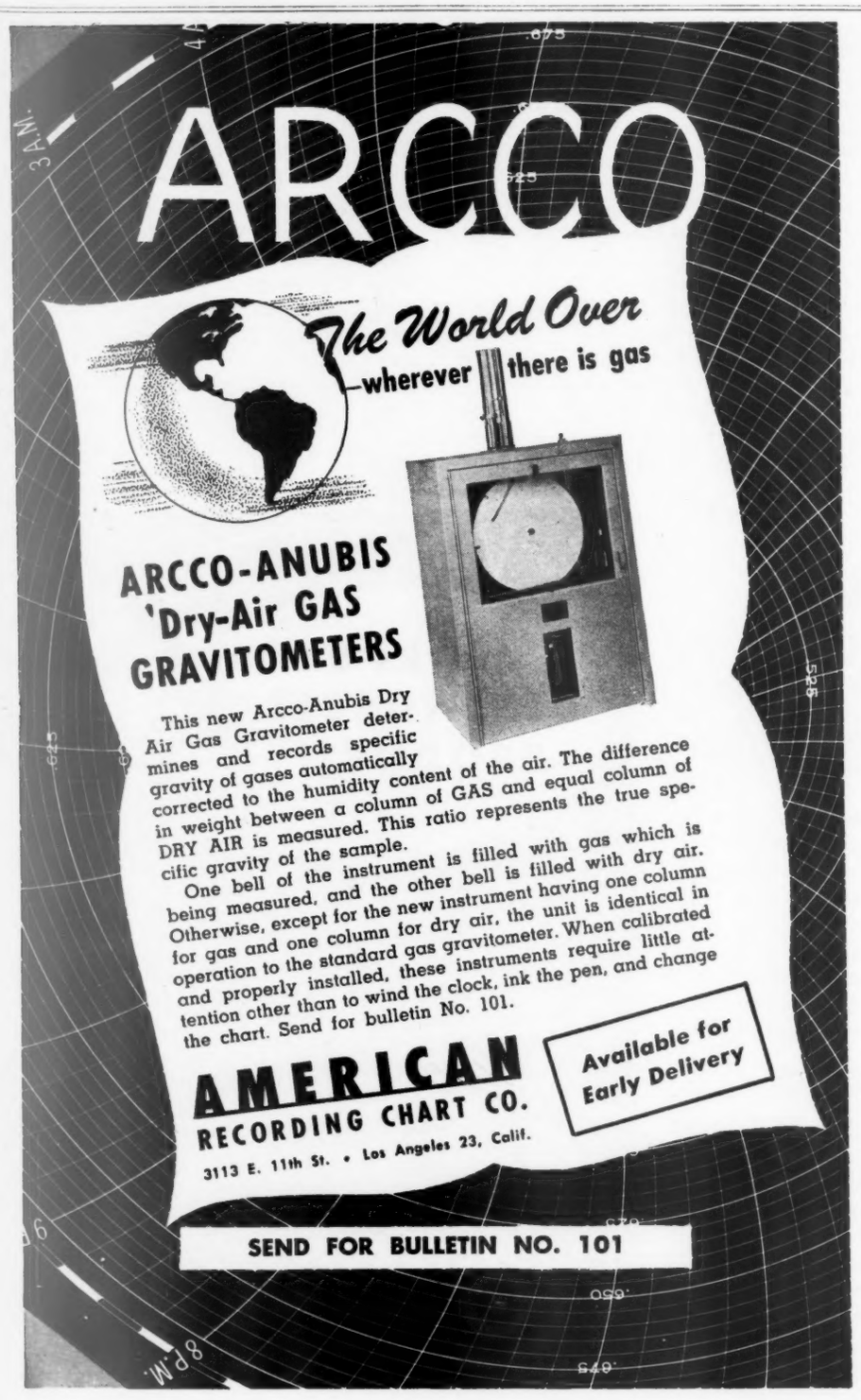
crude oil, 57,500,000 from imports plus 2,100,000 from domestic production.[23] In addition, the country programs provide for gross imports of 18,600,000 tons of refined products and, at the same time, for gross exports of more than 10,000,000 tons of finished products.

23. Import figures used here are taken from the OEEC Long-Term Program report of December 16, 1948, which is based on estimated refining throughput of about 60,000,000 tons. Estimated refining capacity of nearly 66,000,000 tons for fiscal 1953 shown in table J includes revisions made after December 16 by some countries, particularly the United Kingdom, the Benelux countries and Bizonia, and also Austria's total present refining capacity which is located in the Russian zone of occupation.

The above estimated imports and exports of refined products include the quantities moving in intra-European trade. As the product composition of the planned output country by country in many instances may be out of line with the product composition of demand, there will probably be country-by-country surpluses in some products and deficiencies in others. Some of these surpluses can obviously be balanced against some of the deficiencies, but the estimates suggest that Europe as a whole will still be a net importer of some products and a net exporter of others.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A lack of balance in the refining and import-export picture planned for fiscal 1953 is not the only disturbing factor in the unadjusted long-term programs of the various European countries. Another most important consideration that must enter into an evaluation of the program is that there is likely to be a sizable volume of refined products available for Europe in fiscal 1953 from refineries outside Europe. If refining capacity in the Western Hemisphere and in the Middle and Far East should be increased as presently planned, the surplus would probably be near the level of imports of refined products into Europe during fiscal 1949 or fiscal 1950. Part of the refinery expansion program outside Europe results from terms in producing concessions which require the holders to build refineries in the country where the oil is produced. In other instances, the expansion of refining capacity outside Europe is based on economic considerations such as the efficiency of big unit operation; the economy of expanding existing units; and the advantages of flexible operation resulting from having large refineries located near the principal producing areas from which many overseas markets can be economically supplied with a complete range of finished products in line with changing demands.

The program for refining expansion outside Europe of companies of the participating countries has also been presented to the OEEC and is shown in Table J. As the table shows, the refining capacity outside Europe of the companies of the participating countries is expected to increase from 49,700,000 tons at the end of 1947 to 54,200,000 tons in fiscal 1949 and to 72,000,000 tons in fiscal 1953,[24] with the major expansion in the Eastern Hemisphere. The British-, Dutch- and French-owned refining capacity in the Middle East and Far East is scheduled to increase from 26,100,000 tons in 1947 to 40,000,000 tons in fiscal 1953.

The country estimates thus indicate a projected increase in refining capacity between fiscal 1949 and fiscal 1953 of about 18,000,000 tons in the overseas refineries of their companies, in addition to an increase of 38,000,000 tons in European refining capacity. The total expansion during the four-year period, from 82,000,000 tons capacity in fiscal 1949 to 138,000,000 tons in fiscal 1953, would amount to 56,000,000 tons, or an annual average rate of increase of approximately 14

24. Total refining capacity in Europe and of companies of the participating countries overseas, excluding North America, according to national submissions, would be nearly 153,000,000 tons by fiscal 1955, compared with 70,000,000 tons in 1947, a very large increase indeed.

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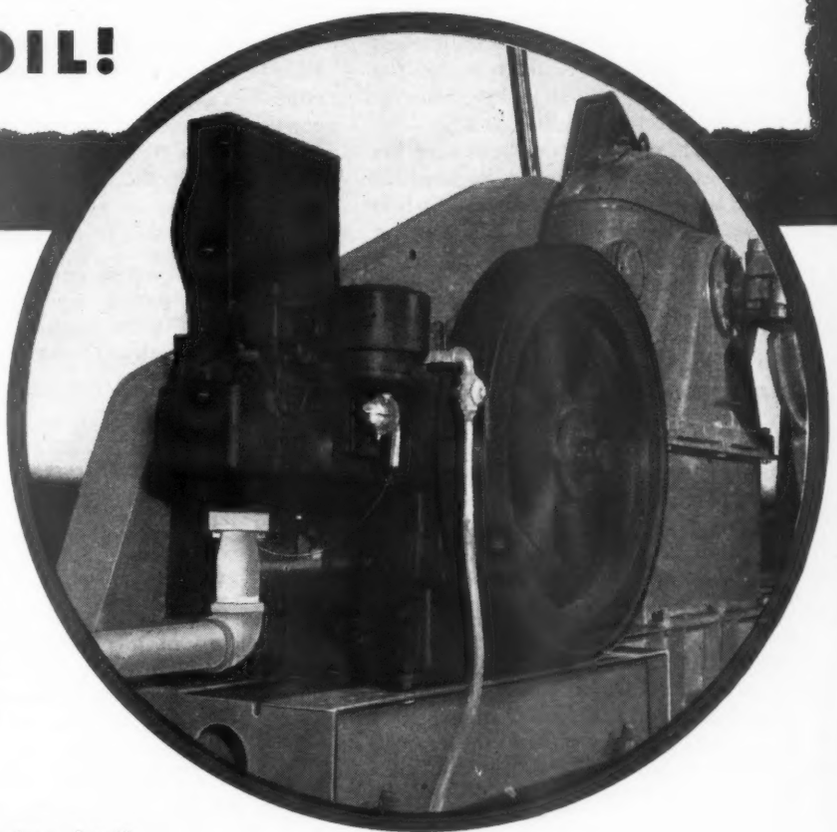

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per cent. This rate compares with an ECA estimated rate of increase in European consumption between fiscal 1949 and 1953 of approximately 6 per cent and a consumption increase in the United States between 1948 and 1949 of about 6 per cent as estimated by the Bureau of Mines.

To illustrate the magnitude of the currently planned increase in another way, European consumption between fiscal 1949 and fiscal 1953 is expected by the individual countries to increase by more than 15,000,000 tons. Since current requirements for refined products can be satisfied on the basis of existing refining capacity, the difference between the total expansion of capacity planned and the increased requirement for finished products in Europe, a difference of more than 41,000,000 tons, would have to find an outlet outside Europe. While part of the increased output undoubtedly could find such outlets in line with the expected increase in market requirements and part of it would obviously be used to reduce British purchases of oil from American companies, necessary today because the British companies' marketing requirements for some products are larger than their own production, it is unlikely that the program as a whole is in line with future market possibilities.

Obviously, in any evaluation of the refining expansion program, account must be taken of the fact that while these figures show the total planned expansion of capacity in Europe, including that of American companies, they exclude any expansion of capacity by non-European companies outside Europe. Additional refining capacity will of course be constructed by non-European companies, particularly by American companies in the Western Hemisphere and in the Middle and Far East, to meet their own increasing world marketing requirements.

In summary,[25] it may be stated that the refining equipment program in and outside Europe must be coordinated with and carefully adjusted to the over-all world oil economy. The considerations that must enter into such an evaluation include the anticipated level of consumption in Europe, the availability of crude oil and refined products from all non-European sources and the market outlets available to companies of participating countries outside Europe. Obviously, too, the plans for expansion, refinery by refinery, and country by country, must be technically and economically sound. The proper location of refineries must be studied carefully and there must be market outlets for their output at competitive prices. If as a result of the refining expansion program new trade barriers were to be erected because Europe could refine oil only by raising import duties on refined products, the cost of oil to Europe would be increased. Refineries that are erected must be in a position to compete with other refineries throughout the world with a minimum restriction to the free flow of trade. It is impossible at this stage to make a quantitative judgment on the adjustments that must be made in the program but it appears that the total program must be reduced ultimately.

25. From the statement made to the OEEC in Paris, December 10, 1948, by the Consultant to the Petroleum Branch, ECA, Washington. It was suggested that the OEEC review the long-term program on the basis of these principles.

The Program for the Expansion of Crude Oil Production

As a corollary to the refining expansion program, the companies of participating countries are also scheduling a considerable increase in crude oil production during the recovery period. European production is unlikely to increase appreciably and, from an over-all point of view, can contribute very little to Europe's oil needs. However, production outside Europe by companies of participating countries is expected to advance very considerably according to estimates submitted to the OEEC which are summarized in the following table:

TABLE K. Estimated crude oil production in participating countries and of companies of participating countries overseas[1] (national submissions).

(In millions of metric tons)

	Europe	Overseas	Total
1947	1.0	54.6	55.6
Fiscal 1949	1.7	74.9	76.6
Fiscal 1950	1.8	89.1	90.9
Fiscal 1953	2.1	113.6	115.7

[1] Excludes all production in North America of companies of participating countries.

As shown in the table above, the production in Europe and of companies of participating countries is expected to increase from 55,600,000 tons in 1947 to 76,600,000 tons in fiscal 1949 and to 115,700,000 tons in fiscal 1953. It is interesting to compare the scheduled expansion in the overseas production of companies of the participating countries with total world production in the area outside the United States, Russia, and Europe, as estimated by the American Petroleum Institute in its Report on the Long-Term Availability of Petroleum, November 1948. According to this report, it is estimated that total crude oil production in the area outlined above, amounted to 130,000,000 tons in 1947, and will rise to about 240,000,000 tons in fiscal 1953. In comparison, the overseas production of the companies of the participating countries in 1947 was 55,000,000 tons or about 42 per cent of the total; in fiscal 1953, it is estimated that their overseas output will be 114,000,000 tons or nearly 48 per cent of total production outside the United States, Russia, and Europe. The large increase in the production of the companies of the participating countries as shown by these figures is, of course, due to their relatively large share in Middle East production, which is expected to show the greatest proportionate increase in world production during the period, about 150 per cent or more than 60,000,000 tons between 1947 and 1953 as compared with an increase of 55 per cent or about 45,000,000 tons in the Western Hemisphere outside the United States.[26]

The total rate of increase of production by companies of the participating countries, as presently planned by such companies, may also be related to the planned increase in refining capacity dependent on crude oil supplies from such companies. The total estimated imports of nondollar crude oil by the participating countries in fiscal 1953 as included in the individual long-term programs plus the quantities of crude oil needed for the refining operations of companies of participating countries overseas in fiscal 1953 are just slightly below the level of nondollar crude oil production[27] tentatively programmed for that year. However, this analysis is based on a refining expansion program which apparently overestimates the demand for finished products. A revision of the refining program would also affect the crude oil program.

The Middle East expansion program of the participating countries, which forms an essential part of the over-all program, is predicted on the availability of transportation facilities among the most important of which are the new pipe lines now being planned or proposed from Iran, Kuwait, and Iraq to the eastern Mediterranean. It should be pointed out, however, that the estimated 1953 production does not fully reflect the increased Middle East output which

26. The API report also estimates that crude oil production in the United States will probably increase by about 65,000,000 tons during the same period, or 25 per cent.

27. The overseas production of 114,000,000 tons of crude oil by companies of participating countries, estimated for fiscal 1953 does not include the oil to be purchased under a long-term contract by a British company from an American company. In addition, several American companies have long-term contracts to purchase crude oil from a British company.

would be possible if and when all the pipe lines are completed at a later date.[28] The disturbed political conditions in the Middle East have already retarded construction of some of these pipe lines. Delay in the Iraq line would limit output from Iraq but a delay in the Iran and Kuwait lines would not necessarily result in a shortfall in the projected increase of production because alternative means of ocean transportation could be utilized.

The problem of the transportation of Midle East crude oil is involved and complicated. The rise in production in that area and the increased dependence of other world areas on the Middle East for supplies, trends which will be accelerated during the remainder of the Marshall Plan period, have occurred so rapidly that there is no general agreement even now on the best method of transportation. In addition, very complex economic, political, and strategic considerations must be weighed in any evaluation of alternative transportation facilities.

Whether or not sufficient tankers would be available to move all oil needed from the Middle East if there should be delays in any one of the pipe line projects is a question that cannot be answered easily. A reasonable conclusion is that tanker facilities could be provided for at least a substantial part of requirements if there were indications at an early enough time that such an expanded world tanker fleet would find employment in the future and if over-age tankers were kept in service.

As stated before, the income that is expected from the increased sales of crude oil as well as of refined products will constitute an important element in the future balance of payments of some participating countries. It must, however, be realized that, if such expansion greatly exceeds the absorptive capacity of the markets of the companies of the participating countries, it will lead to a displacement of dollar oil, especially in soft currency markets where nondollar oil enjoys a competitive advantage as a result of the dollar shortage of the importing countries. Such displaced dollar oil, may therefore, try to capture an increased share of the strong currency markets. As a result, nondollar oil may find itself left with the major supply responsibility for soft currency markets and lose income in hard currency markets.

Under such conditions, the over-all recovery goal of the oil expansion program would not be achieved because the dollar savings of oil-importing, soft currency countries would probably be counterbalanced by the loss of dollar income by the oil-suppyling countries resulting from a reduction in their sales to hard currency markets. However, a well-conceived program[29] of crude oil development by companies of the participating countries may be one of the most effective means of self-help available to those countries, particularly the United Kingdom.

28. The major Middle East pipe line projects now being planned or proposed by companies of the participating countries will have an annual throughput of 65,600,000 tons when completed, which could be increased by 14,000,000 tons to 79,600,000 if desired by installing additional pumping stations. Plans for many of these projects are not final and not all of them may be carried out. Even if all the pipe lines now planned are eventually built, not all of them will be completed during the recovery period. In addition, the Saudi-Arabian pipe line, construction of which has already started, has a planned annual throughput of 15,000,000 tons which could be increased by 10,000,000 tons to 25,000,000 if desired.

Value of Petroleum Equipment Requirements

Figures are available for the value of the equipment program as estimated by the participating countries for fiscal 1949 and 1950 only. In summary, the requirements are as follows:

In fiscal 1949, the dollar value of the equipment required has been estimated by the participating countries at $573,000,000 of which $192,000,000 worth will have to be obtained from dollar sources and $381,000,000 worth from nondollar sources.

In fiscal 1950, the total value of equipment has been estimated at $592,000,000[30] of which $211,000,000 worth would have to be obtained from dollar sources and $381,000,000 worth from nondollar sources. The dollar source figure includes estimates for both ECA and non-ECA financed equipment. In fiscal 1949, it was estimated that ECA financing would be required for approximately $117,000,000;[31] no comparable estimate has been made for 1950.[32]

Nearly two-thirds of the value of the equipment to be procured from dollar sources in fiscal 1950 by all participating countries is for the United Kingdom and about a fifth for Italy and France. A large part of the equipment to be procured from dollar sources, as estimated by the individual countries, is for overseas operations. Of the total value of $211,000,000, $108,000,000 or 51 per cent will be spent for equipment to be used in the participating countries; $32,000,000 or 14 per cent in the overseas territories; and $72,000,000, or 35 per cent in nonparticipating countries.

Equipment required for the refining program accounts for more than half the value of the total equipment program as estimated by OEEC for fiscal 1950; production equipment accounts for 22 per cent of the total value; and the remaining amount is for storage equipment and pipe lines. A high percentage of total requirements is for MRO items.

The estimate of $211,000,000 for the total value of equipment required from dollar sources in fiscal 1950 includes in general the needs of American companies operating in Europe

TABLE L. Estimated value of petroleum equipment required in Europe and overseas (national submissions).

(In thousands of dollars)

Type of equipment	Fiscal 1950			Fiscal 1949		
	Dollar sources	Nondollar sources	Total	Dollar sources	Nondollar sources	Total
Drilling	53,744	51,694	105,438	38,906	30,955	69,861
Well casing	13,800	17,122	30,922	17,400	16,800	34,200
Refining	124,127	189,129	313,256	84,877	116,414	201,291
Transportation and distribution	[1]	[1]	[1]	10,957	71,923	82,880
Storage	15,260	81,003	96,263	9,104	62,287	71,391
Pipe lines	2,645	40,850	43,495	25	19,800	19,825
Miscellaneous	[1]	[1]	[1]	31,271	62,429	93,700
Undistributed	2,000	1,000	[2] 3,000	.....	.....	.....
Total	211,576	380,798	592,374	192,540	380,608	573,148

[1] Not included in national submissions.

[2] These figures represent the program for French overseas territories for which no distribution by type o equipment is available.

Note—For the purpose of this table, estimates have been used as prepared by the participating countries; they include all equipment required by American companies operating in the participating countries and operating in joint ventures with British companies overseas.

29. It should be noted also that the production programs were drawn up at a time when it appeared likely that the continued increase in world petroleum requirements would be of such magnitude as to justify and necessitate a maximum program for the expansion of world crude oil production. Since that time, however, the flattening of the consumption curve especially in the United States, has led to considerable cut-backs in present production. Forward production estimates must, of course, take careful account of any change in consumption trends as evidenced by present experience.

30. The total of 592 million dollars for fiscal 1950 is not directly comparable with the total of 573 million dollars for fiscal 1949 because of the difference in coverage as shown in table L.

31. ECA financing of equipment up to the end of 1948 was only a small part of the amount estimated by the countries for financing in fiscal 1949.

32. A figure for the value of petroleum equipment is included in the merchandise balance of the participating countries for fiscal 1950, except in the case of the United Kingdom for which it is included among invisibles with other payments referring to the British oil industry.

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and operating jointly with British companies overseas. In connection with the requirements of American companies in participating countries, it should be pointed out that their subsidiaries are an integral part of the economy. They pay taxes just as any other oil company operating in these countries does and the output from their refining facilities will benefit Europe in the same manner as output from the refining facilities of national companies.

To the extent that equipment is required from the United States, therefore, it seems only equitable that American companies should be treated in exactly the same way domestic companies are treated. This policy is in line with that expressed in Commodity Report G of the Executive Branch of the United States.[33]

However, a major part of the refining projects being undertaken by American companies in Europe will be financed by them in line with agreements reached between the individual company and the country in which the expansion is planned. It appears, indeed, that a very large part of the new capital needs of subsidiaries of American companies operating in the participating countries will, in fact, be financed by new investments from the dollar resources of their parent companies and thus will be a net increment to the dollar resources of the countries in which they are located.

On the basis of all the considerations that should enter into the evaluation of the fiscal 1950 program as part of the long-term oil expansion program, and which have been discussed previously, it is estimated that the value of equipment required in fiscal 1950 will be reduced from the amount originally estimated on the basis of national submissions. Taking further into consideration that a substantial part of the program is expected to be financed by new dollar investments made by American companies whose subsidiaries are operating in the participating countries and eliminating the capital needs of American companies operating jointly with British companies outside participating countries, it is estimated on a provisional and highly tentative basis that the participating countries' own expenditure for the purchase of equipment from dollar areas may be somewhat over $100,000,000 in fiscal 1950.[34]

33. In this connection, it should be unnecessary to point out that, if and when ECA finances petroleum equipment imports, the companies which obtain the equipment pay for the equipment with their own resources of local currency.

34. A more definite figure can be established only after the OEEC's Technical Oil Committee has completed its analysis and evaluation of the equipment programs of the participating countries.

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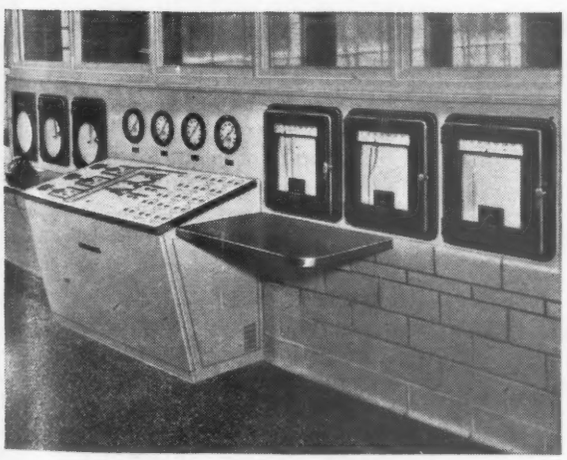
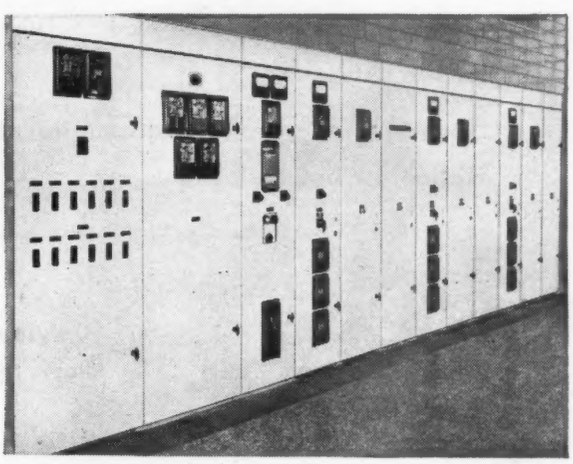
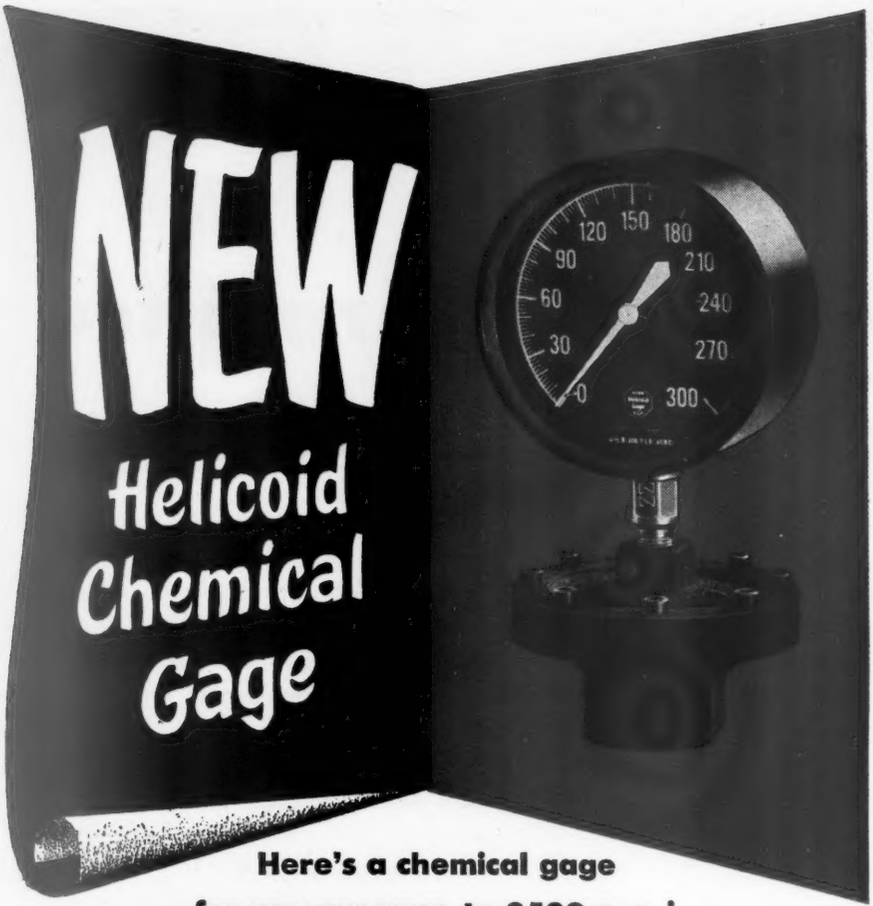


This control desk in a semiautomatic station has flow recorder and controllers for station suction and discharge pressures at left, pushbutton co-ordinated electrical control for pump units and motorized valves in center with pressure gages on panel above, and protective thermocouple recorders at right.



"Unitized" Metal-Clad Switchgear in a semiautomatic pump station, showing (left to right) low-voltage distribution, sequence control for automatic operation of pump units and valves, control of the outdoor main breaker, and reduced-voltage starting equipment for three main-line pump units.



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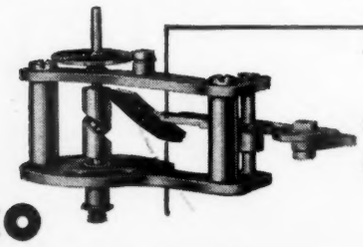

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Requirements for Petroleum Equipment From the United States

It appears certain that a substantial expansion program for refining operations in Europe and for the operations of the companies of the participating countries outside Europe is economically justified and necessary in order to achieve European recovery. It also appears possible that some of the equipment required for such an expansion program may compete with the needs of the American oil industry both in and outside the United States.

In examining the division between equipment to be obtained from the United States and that to be obtained within the participating countries, attention should be paid to the fact that the United States equipment industry is the largest in the world, unexcelled in its technical know-how and efficiency. Many intricate pieces of equipment are now manufactured only in the United States; in addition, the European equipment industry which is smaller and less experienced than the United States industry is not able to provide the necessary technical know-how in many instances.

On the other hand, the relatively high share of equipment which it is estimated can be obtained from nondollar sources, $381,000,000 worth or 64 per cent of the total in fiscal 1950, indicates the great progress that has been made in this field during the last few years. The pipe line projects for the Middle East are also based on a maximum utilization of equipment from nondollar sources. The two 16-in. Iraq pipe lines are being built with European steel but, as no European mills can manufacture very large diameter pipe, steel will be needed from the United States for the "big-inch" Middle East and Iraq pipe lines. However, construction of the "big-inch" lines will not begin for some time and they will not be built simultaneously, so that the requirement for steel from the United States, if and when construction begins, will be spread over several years.

With the limitation of the size of the petroleum equipment program as tentatively suggested above, the requirement for materials from the United States may also be lowered. If materials are available, United States suppliers of specialized equipment, judging from current trends in backlog of orders, will be a reasonably good position to meet requirements for equipment. Important suppliers of specialized refining equipment have

recently reported improving deliveries and appreciable contraction of backlogs in the last few months; in general, booked orders represent 6 to 18 months' production, the lowest in some years; reasonably prompt deliveries can be made on standard drilling rigs and other production equipment; and pumping equipment is in relatively easy supply.[35]

In this connection, it should be emphasized again that the participating countries are making determined efforts to expand their own petroleum equipment manufacturing industries so that they can themselves furnish the bigger portion of equipment and materials requirements, especially tanks, drill pipe, casings, and much of the smaller diameter line pipe. The success of the total program as it is ultimately determined will depend as much on the efforts of the participating countries in this respect as it does on the availability of specialized equipment from the United States. If total planned capacity is reduced as suggested here, there can probably be some switching from dollar to non-dollar sources so that the value of the equipment required from the United States may be cut even further. However, the amount of switching that will be possible may be limited because a large part of the dollar requirements is for specialized equipment not available within the participating countries.

In any case, each petroleum equipment project included in the European Recovery Program must be considered in relation to the availability of equipment in the United States.[36] The advantages to be derived from each project will be weighed against any disadvantage that might result from depriving the American industry of needed equipment. It should, however, be stated that in many instances the petroleum equipment requirements for the European Recovery Program constitute only a marginal part of the United States equipment production.

By making petroleum equipment available to the participating countries for uses that are coordinated with operations of the world's oil economy, the European Recovery Program will aid them positively and on a substantial scale in their undertaking to become independent of outside economic assistance.

35. Source: Statement by the Machinery Branch, Office of Domestic Commerce, Department of Commerce to the Economic Cooperation Administration.
36. The ultimate responsibility for the protection of United States' equipment users rests with the Department of Commerce which, under the authority delegated to it by Congress, determines whether or not export licenses shall be granted for specific materials in short supply in the United States.

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Soon after Vaughey was born in Marseilles, Illinois, on September 16, 1904, his parents moved to Tulsa in what was then Indian Territory. There his father, E. A. Vaughey, became an independent operator and producer and young Bill got his first taste of the excitement of the oil business.

However, in a few years the senior Vaughey took his family to Albuquerque, New Mexico, where Bill grew up, attending the public schools and for a short while New Mexico University.

After a brief whirl at the securities business in Los Angeles, Vaughey went back to Tulsa in 1925 to take a job in the map room with the newly organized Philmack company, which had been set up by Waite Phillips, R. Otis McClintock, and Gillette Hill. Through a series of mergers this eventually became the Independent Oil and Gas Company and Vaughey graduated to scout and land man.

When the Independent Oil and Gas Company merged with Phillips Petroleum Company, Vaughey accepted a position with a subsidiary of Electric Bond and Share Company to acquire gas properties in Pennsylvania.

With that assignment finished he returned home to the Southwest to organize W. M. Vaughey, Inc., and drilled a series of wells in Southeast Texas in the Luling area. In 1939 he sold this company and its production and moved to Houston to form a partnership with his brother, Emmett A. Vaughey.

Vaughey and Vaughey were operating in the Texas Gulf Coast area when the oil play moved to Mississippi and Bill arrived on the scene the day following the drillstem test of the state's discovery well in Yazoo County.

Quick to sense the possibilities of oil and gas production in the Magnolia State, Bill Vaughey stayed on and in 1942 Emmett Vaughey closed their Houston office and with the firm's junior partner, W. T. Blackburn, moved to Mississippi.

W. M. "BILL" VAUGHEY

Vaughey and Vaughey now have production in six Mississippi fields and in the Delhi field in Louisiana.

Bill Vaughey soon became a recognized spokesman for the oil and gas industry in Mississippi. Realizing the need for a modern conservation law, he traveled all over the state to appear before civic clubs and meetings with Mississippi legislators and members of the press to urge its enactment.

He has served several terms as vice president and president of the Mississippi-Alabama division of the Mid-Continent Oil and Gas Association and is currently a director of the general Mid-Continent Association. He is a member of the API, and is also serving as a director of IPAA.

Vaughey has taken an active part in civic and social affairs of Jackson. He is a director of a large Jackson bank and a member of the Advisory Committee of St. Dominics hospital. He has served three terms as a director of the Jackson Community Chest, and has been a vice president and member of the Board of Governors of the Jackson Country Club. He is also a colonel on the military staff of Governor Fielding L. Wright.

In 1932 Vaughey married Genevieve Cowman of Oklahoma City and they have four children; Bill, Jr., 12 years old, John Cowman, 10, Sandra, 6, and Patricia, 4.

As for sports, Vaughey's favorite is deep sea fishing and when the pressure of business gets too great you'll find him with his family or friends taking off for Tampico or Guaymas, Mexico, in his five-passenger Beechcraft.

He's as successful a fisherman as he is an oil man, for decorating the walls of the Jackson Petroleum Club is a large sailfish, tangible evidence of his prowess with rod and reel.

"I've just been lucky all around," he grins, and if you didn't know better you might believe him!

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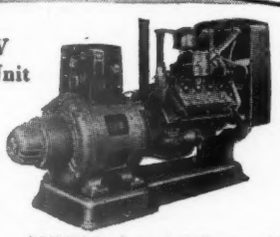

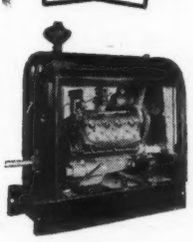

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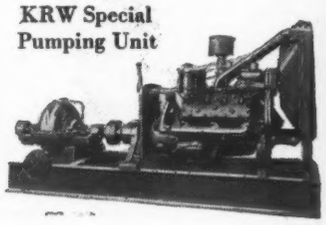

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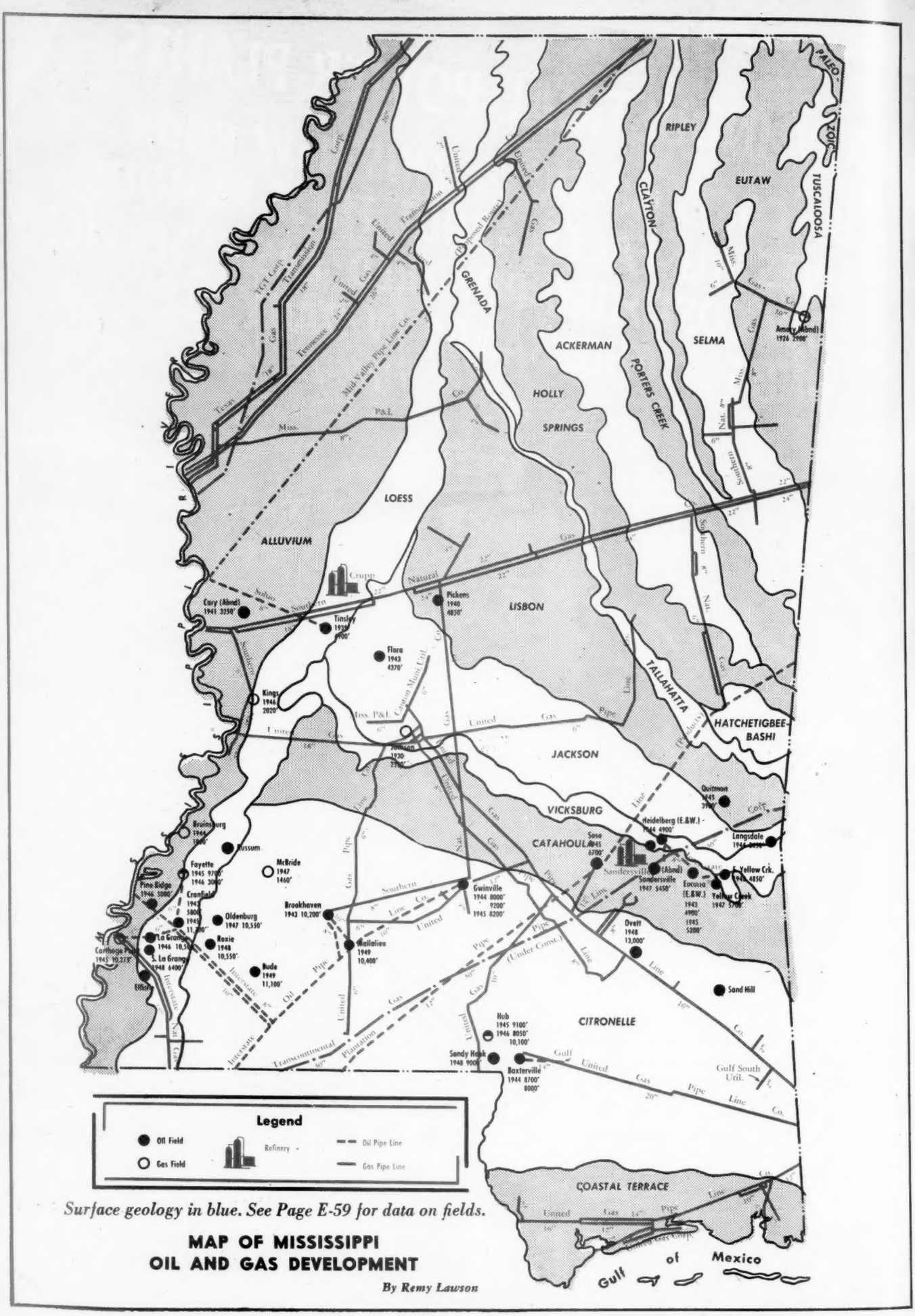
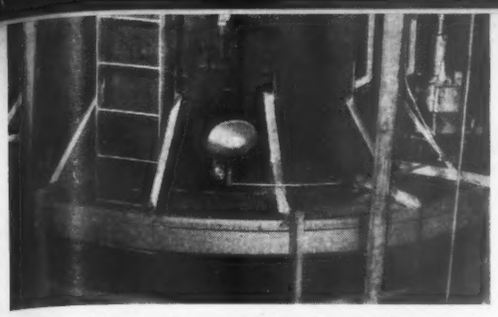


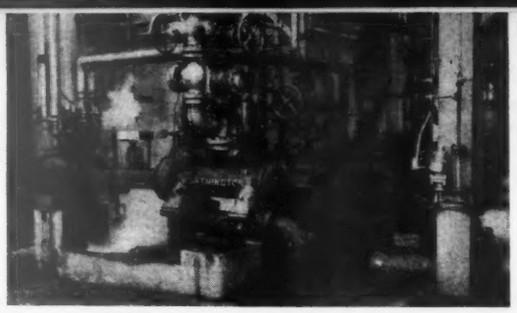
Surface geology in blue. See Page E-59 for data on fields.

MAP OF MISSISSIPPI
OIL AND GAS DEVELOPMENT

By Remy Lawson



Worthington deaerating feed water heater



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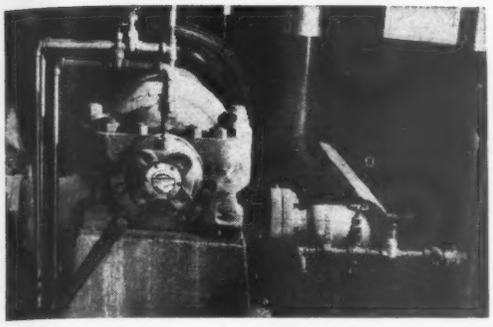
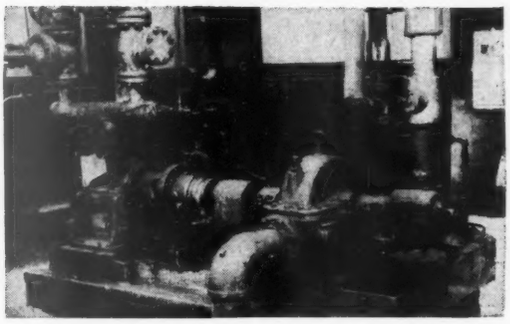
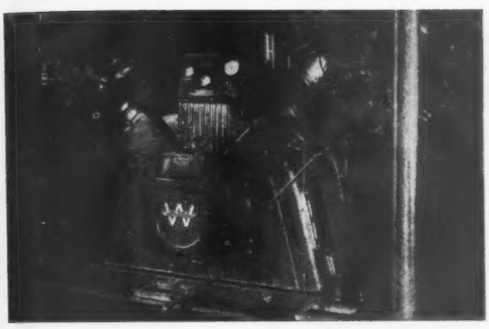


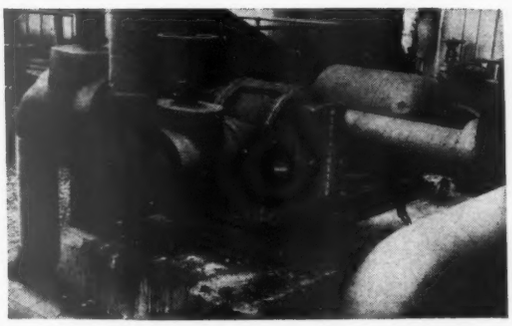
Worthington feed water pump



Worthington-Moore turbine-driven pump



Worthington air compressor



Worthington rotary asphalt pumps

Most Everything Here Is Moved By Worthington

Worthington equipment plays an important part in handling water, air, crude oil and refined products at the refinery of a large independent in the Chicago area.

Water for cooling purposes is pumped, in tremendous quantities, from a large canal to the refinery by a Worthington circulating pump, a Type 16-LA-2, driven by a 250 hp motor. It supplies 7000 gpm against a 120 ft head, and has been doing this for more than 10 years, 24 hours a day, without shutdown except for normal maintenance.

In the boiler room, feed water is preheated to almost 250 deg. before entering the boiler by a Worthington deaerating feed water heater. The present heater of the steam jet type was purchased a year ago to remove oxygen from the water in order to lower corrosion in the boiler tubes. It is rated at 225,000 pounds per hour, and replaced a Worthington Type N6 which had been used for 15 years and was still in perfect condition but not of large enough capacity to meet the new conditions.

At the same time, a new boiler feed pump was installed to take care of the added capacity. It is driven by a 125 hp motor and furnishes 500 gpm against a 600 ft head.

Compressed air to operate power tools and instruments is furnished by two Worthington Air Compressors purchased 15 years ago, and a new Type YC2 with 798 cfm capacity was added to the group in 1945 and has been been running continually since then.

To drive oil through the stills, a centrifugal hot oil charge pump is used. It is driven at 3600 rpm by a Worthington 450 hp condensing steam turbine and is serviced by a Worthington barometric condenser.

This unit replaced an old Worthington reciprocating plunger type pump which had been purchased in 1931. The old plunger type was over 40 feet long, compared with 10 feet for the turbine type.

Cracked gasoline is pumped to the stabilizer by a Worthington-Moore turbine-driven pump, 1300 lb on suction side, 325 lb on discharge. This pump is unique in that it has a mechanical seal which has eliminated packing scoring with its subsequent leaking, and consequently it requires much less maintenance and runs longer without shut downs.

Three Worthington HiVol reciprocating steam pumps are used in the production of propane. The 18x8½x18 pumps the impure LPG into the depropanizor tower; the 12x8x18 reflux pump is part of the control of the process on the tower; the 10x6x12 is used for standby duty.

Two Worthington type 6-GR rotary asphalt pumps, driven by 40 hp motors, circulate the asphalt from the storage tanks through a heater and back to the tank to prevent the asphalt from solidifying. They are also used to pump the asphalt into tank cars and tank trucks.

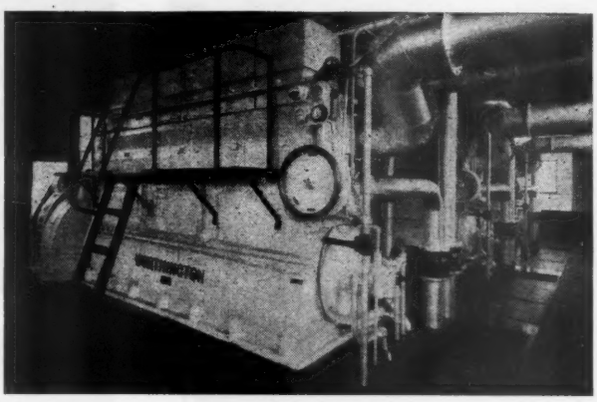
NEWS

FROM THE PETROLEUM FRONT

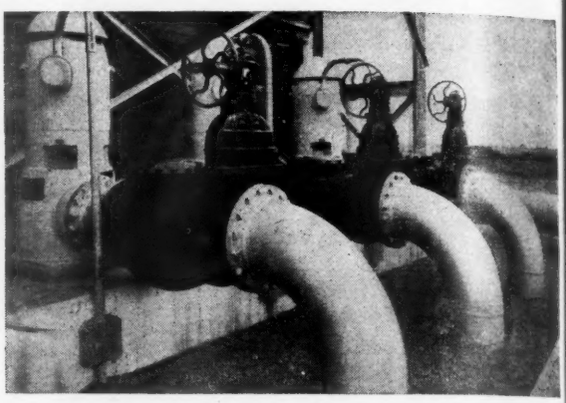
AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

1

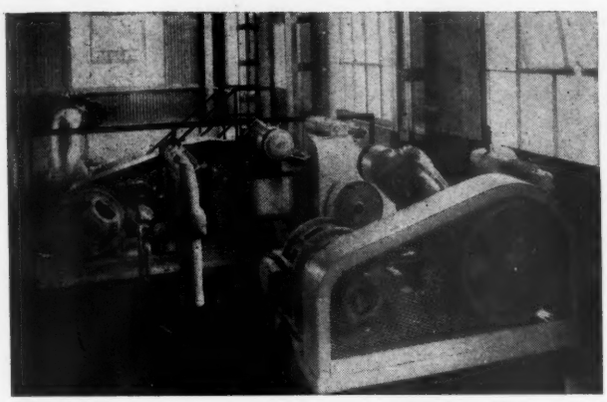
NEWS from the petroleum front



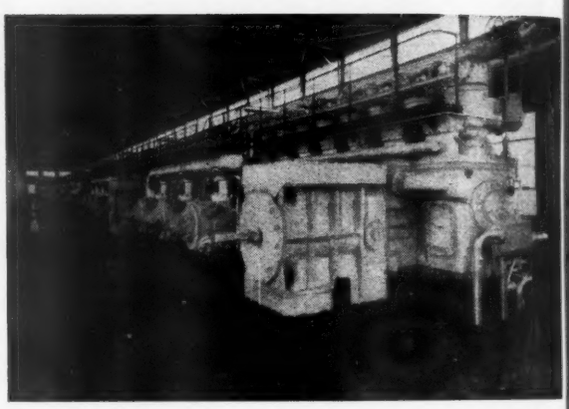
Three Worthington auxiliary engines in gas compressor station at Tennessee Gas Transmission Co., East Bernard, Texas



Worthington vertical turbine pump circulating water over cooling tower in main line gas compressor station at Tennessee Gas Transmission Co., East Bernard, Texas

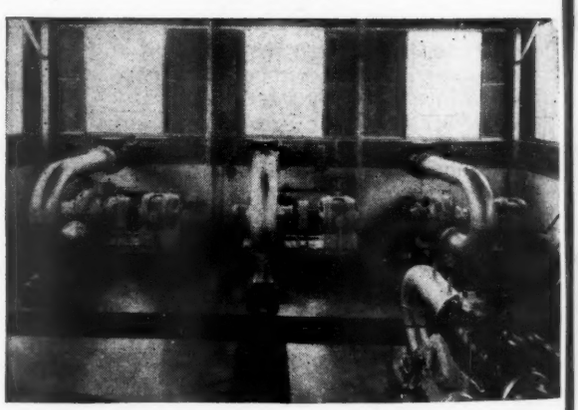


Worthington Air Compressors for starting engines in main line booster station, Tennessee Gas, East Bernard, Texas



Eleven Worthington compressor engines in main line compressor station, Tennessee Gas Transmission Co., East Bernard, Texas

Five Jobs For Worthington At Tennessee Gas Transmission Company



Worthington 10" water pumps handling jacket water to auxiliary engines, Tennessee Gas Transmission Co., East Bernard, Texas

The East Bernard, Texas plant of the Tennessee Gas Transmission Company is now using Worthington vertical turbine pumps, gas compressors, gas engines, starting air compressor units and centrifugal pumps to handle natural gas in the pipe lines from South Texas to West Virginia.

All this equipment was installed in 1944, and has been operating satisfactorily since that time. Three vertical turbine pumps circulate the cooling tower water over the cooling tower in the gas pipe line compressor station. Similar pumps are used at station No. 4 at Jasper, Tex., station No. 6 at Monroe, La., and station No. 7 at Greenville, Miss.

Eleven compressor engines in the main line station, the second compressor station on this gas pipe line, handle approximately 360,000,000 cubic feet of natural gas per day.

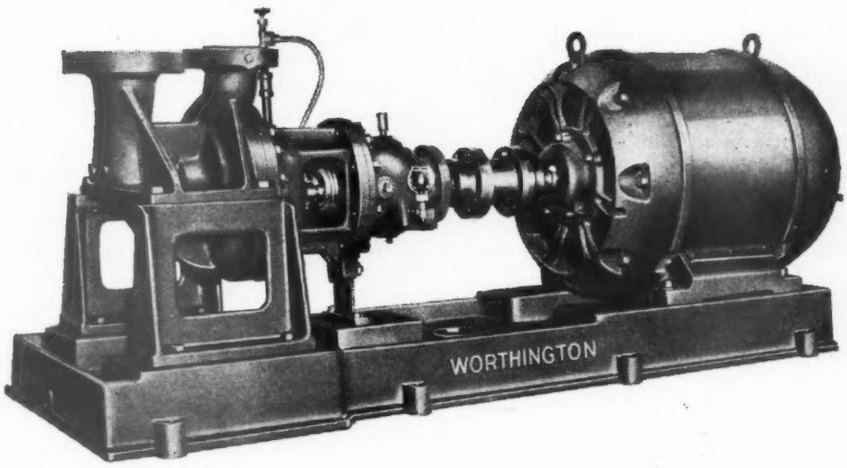
Three CCF-6 Worthington gas engines drive Westinghouse generators for supplying electric power for gas pipe line compressor station.

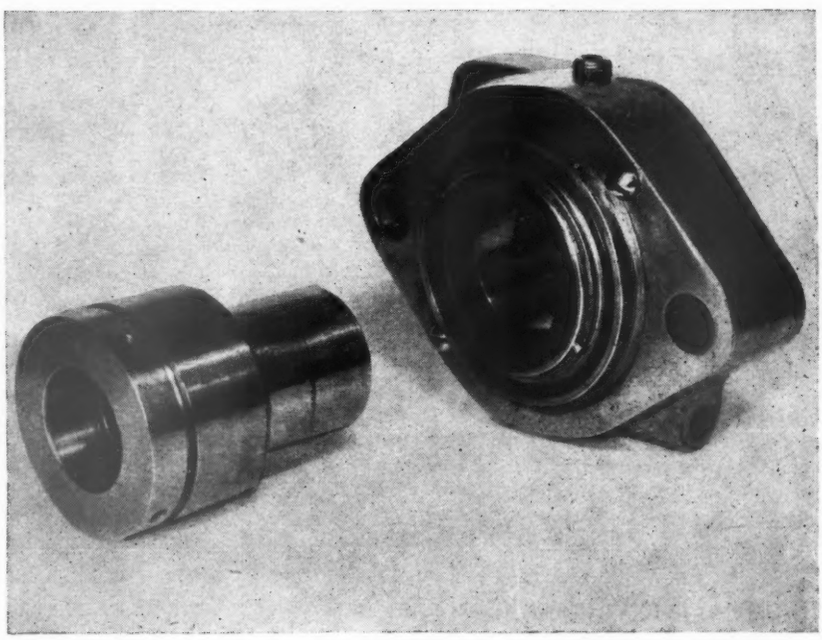
Three 12LA-1 60 hp centrifugal pumps and two 6L-1 25 hp centrifugal pumps supply jacket water for cooling gas engine driven pipe line compressors. Similar pumps are also installed at stations No. 4 at Jasper, No. 6 at Monroe and No. 7 at Greenville.

Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS

Mechanical Seals for Centrifugal Refinery Pumps





Because satisfactory stuffing box operation is necessary for a successful pump operation, Worthington has spent several years investigating the problems presented by high pressures and non-lubricating liquids now common in the petroleum refining and petrochemical industries.

The result of this investigation is the development of a single mechanical seal to be used in the stuffing box of process pumps handling light hydrocarbons at high pressures.

The first objective in Worthington's development work was to eliminate the costly seal oil system and the frequent replacement of conventional packing. At the same time, it was decided to keep the mechanical seal as simple as possible so that it could be installed, operated and maintained by normal refinery personnel at a minimum of cost.

This has been accomplished by making the rotating element a simple, streamlined assembly—as shown in the picture.

It is streamlined to eliminate churning in the liquid and has been symmetrically designed so that vibration at any speed is eliminated. The stationary element provides the necessary flexibility for a seal of this type and is an assembled unit that requires no adjustment on the pump, or during the assembly of the pump and seal. The materials used for the rotating and stationary seal faces are such that friction is reduced to a minimum and by incorporating hydraulic balance, long life is assured.

Single mechanical seals eliminate the possibility of contamination of product with seal oil and make it unnecessary to use high pressure seal oil pumps with control valves. Auxuliary packing glands can be furnished where safety requirements make it mandatory to control closely the vent vapors.

The type G mechanical seals are installed in Worthington refinery type process pumps as optional equipment for pressures up to 500 psi and temperatures up to 250 deg. F. Interchangeability is kept at a maximum by using three sizes of seals for 24 different sizes of process pumps. Modifications can be made in these seals for higher pressures and temperatures. The same general design of seal is used for high pressure, high speed pipeline pumps where continuity of service is an important factor, and where leakage is expensive and highly undesirable.

Woodruff Well Began Mississippi Oil Industry Just 10 Years Ago

B. G. Barnes

On September 5, 1939, a new industry was born in Mississippi. On that memorable date, at a location ten miles southwest of Yazoo City, a Union Producing Company drilling crew completed Mississippi's first oil well at a depth of 4550 ft. The well, now famous in the state, was Woodruff No. 1, in the Tinsley Field.

The Woodruff No. 1 is still a producer, and is one of more than 100 operated by Union Producing Company, an affiliate in the United Gas organization, in the Tinsley Field.

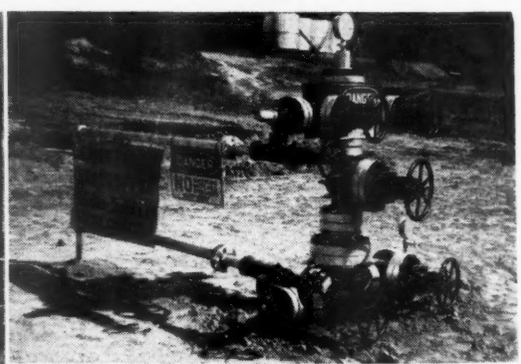
B. G. Barnes, the man who supervised completion of the discovery well, is now drilling and production superintendent of the Jackson district of Union Producing Company. He has worked with Union and its predecessor companies for nearly 30 years.

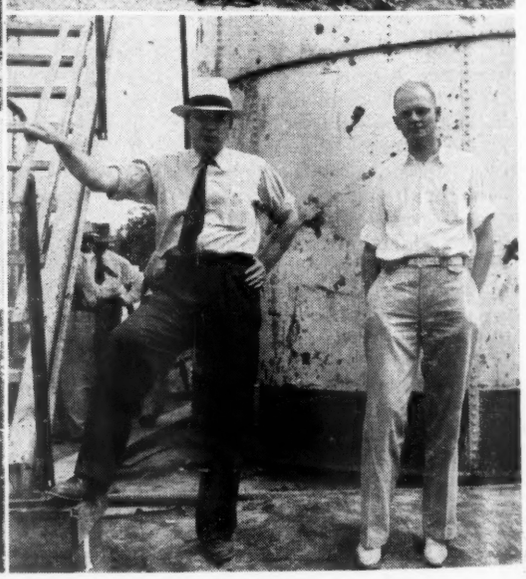
Barnes was born in Carthage, Texas, attended school there, and followed the occupation of farming in Panola County for several years. Then, in November, 1919, he entered the oil business as a driller's helper with one of United's predecessor companies. Advancing successively through the positions of driller, drilling foreman and field drilling superintendent in the Monroe, Louisiana, district, he was transferred to the Jackson district in November, 1939, to continue his duties as field drilling superintendent. Barnes was promoted to his present position September 1, 1942.

Other members of the crews which brought in the Woodruff discovery were Preston Fergus, Ed Lytle, and J. B. Storey in charge of geological phases of the drilling work; drillers J. L. Francis, W. C. Hines, G. G. McCallum, and T. E. Smith; drillers' helpers J. B. Baker, C. L. Bigby, J. G. Blake, G. E. Bruton, J. M. Danner, J. E. Ferrell, W. A. Garrott, N. A. Harrell, A. C. Kilcrease, J. M. McLemore, J. B. Moody, A. L. Moore, R. C. Nichols, O. A. Payne, C. L. Ramsey, F. G. Walker and S. B. Walker.

The Woodruff discovery not only brought another industry to Mississippi—it created a new source of income for the state and its people. The well climaxed more than a third of a century of persistent exploratory effort, backed by an abiding faith in the productive possibilities of Mississippi.

Upper left: Thousands came to see the Woodruff No. 1; right, Christmas tree on Union Producing's discovery well.
Lower left: G. C. Woodruff, owner of land; right, Company geologists on the job, Preston Fergus and J. E. (Ed) Lytle.



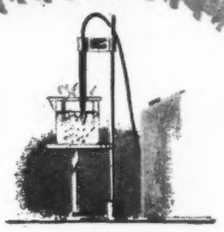


VIRTUALLY UNBREAKABLE!

So *strong* that the pH-sensitive bulb can withstand as much pressure as the thick stem itself!

Abrasion resistant—unusually rugged for long life and reliable measurement even in highly abrasive slurries!

Chemical durability—excellent in the strongest acids and alkalis . . . even at elevated temperatures!

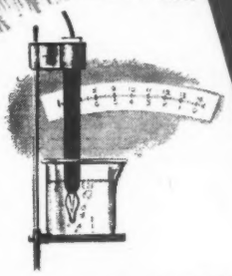


COVER EXTREME TEMPERATURES!

30° to 130° C at high pH—with the new high temperature—high pH glass.

—20° to 100° C—with the new general-purpose glass. Will withstand even repeated freezing.

Now- NEW BECKMAN pH Electrodes



UNPRECEDENTED pH RANGE!

0 to 14 pH—with the high-temperature high-pH glass . . . *only small reproducible deviation near extreme limits, even at high temperatures.*

0 to 11 pH—at room temperaperature and 0 to 10 pH at boiling for the general-purpose glass . . . *without* correction for sodium ions!

IMPROVED CONSTRUCTION!

Simplified, heat-resistant construction eliminates wax filling . . . retains patented Beckman internal shielding . . . increases measurement precision.

Only *Beckman Glass Electrodes* offer all of these features:

- **RAPID RESPONSE** . . . accuracy with speed and convenience.
- **STABILITY** . . . to match the high precision of BECKMAN pH METERS.
- **INTERNAL SHIELDING** . . . gives complete freedom from outside electrostatic interference.
- **INTEGRAL LEADS** . . . Continuous insulation into the electrode . . . connections located on protected panel board.
- **EXTREME TEMPERATURE RANGE** . . . Several types permit use from below freezing to boiling *and above!*
- **ENTIRE pH SCALE** . . . *Very small* sodium ion errors . . . e.g., with high-temperature high-pH glass, only 0.2 pH deviation at 13.7 pH in 1 N sodium hydroxide.
- **FACTORY SEALED** . . . rigidly tested . . . no maintenance.
- **UNIQUE CHEMICAL DURABILITY** . . . in alkali . . . in acid . . . in dilute solutions.

And . . . *REALLY TOUGH* . . . can even be used as a stirring rod!

These new electrode glasses are now being used in several Beckman electrode styles. As rapidly as possible, they will be available in the full line of Beckman Glass Electrodes.

Constant Research over the years has maintained Beckman Leadership in the instrumentation field . . .
—Beckman *pH Meters and Glass Electrodes*
—Beckman *Ultraviolet, Visible and Infrared Spectrophotometers*
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Mississippi's Deepest Well

THE deepest well in Mississippi was drilled in 1946 by The Superior Oil Company of California, which has an experienced drilling department for deep operations.

An account of the operation is interesting for several reasons. One is that the electric log was run to 15,674 ft and perforations that followed found shows in several sections below 12,000 ft. The well was a rank wildcat; there is no oil or gas production in the county.

Another reason the operation commands attention is the care with which the well was drilled to get the greatest amount of information from the project whether oil and gas were found.

Superior located its No. 1 Cassie Bradford well 330 ft north and 330 ft west NE SW NW sec 1, T 3 N, R 13 W, Forrest County, Mississippi. The well was spudded on May 14, 1946 and drilled with a rotary type company rig.

No trouble was encountered in drilling operations to the total depth of 15,730 ft, which was reached on October 30, 1946.

A Schlumberger log of the well was run to a depth of 15,674 ft. See accompanying figure for log below 12,000 ft. A total of 122 Schlumberger sidewall sample cores and 54 conventional cores were taken.

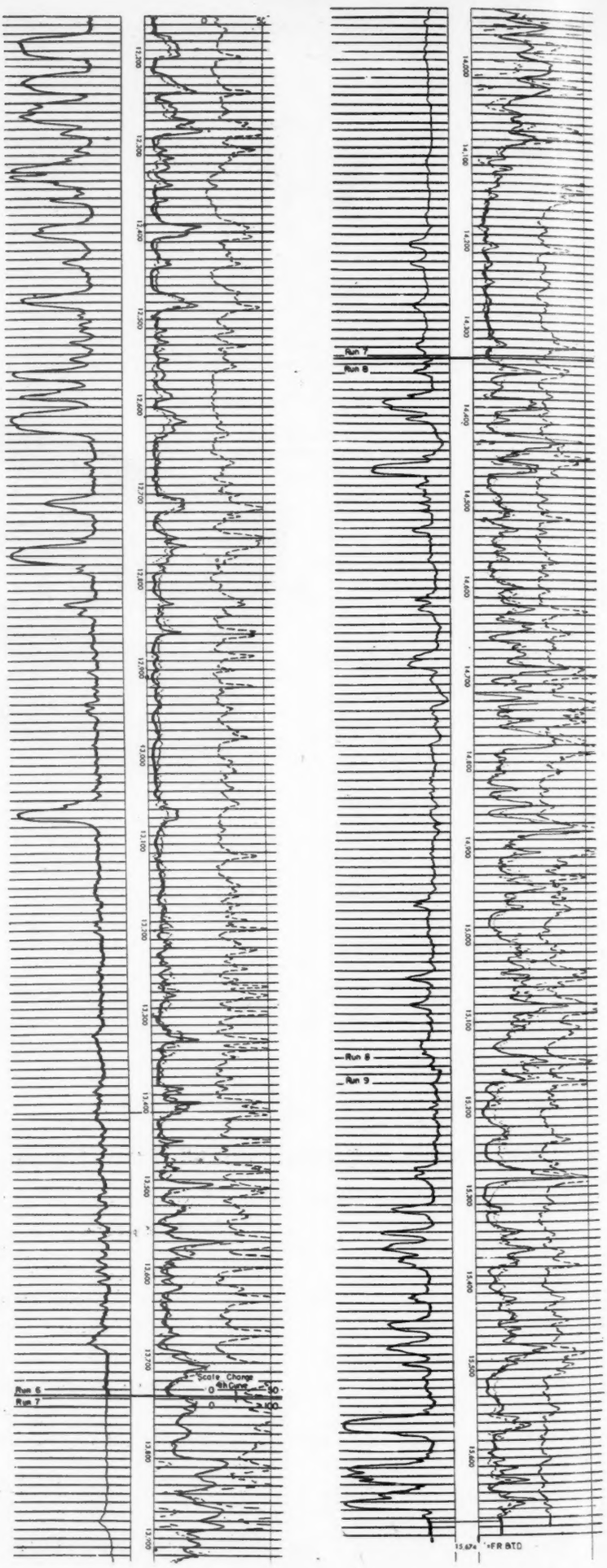
The following casing program was set in the well: 11¾ in. OD 47-lb Seamless Grade J-55 set at 1287 ft and cemented with 1300 sacks cement. 7⅝ in. OD 33.70 lb and 39 lb Grade N-80 set at 12,128 ft and cemented with 2000 sacks cement. 5 in. OD 18 lb Grade N-80 set and cemented as liner from 12,066 ft to 15,722 ft, with 700 sacks cement.

The following drillstem tests were made in the well: No. 1—Perforations 15,552 to 15,572 ft—Recovered mud and salt water. No. 2—Perforations 14,452 to 14,468 ft—Recovered salty mud. No. 3—Perforations 13,305 to 13,335 and 13,375 to 13,420 ft—Recovered mud with show of oil after swabbing. No. 4—Perforations 12,750 to 12,765 ft—Recovered salt water with very slight show of oil. No. 5—Perforations 12,468 to 12,490 ft—Recovered salt water with show of oil. No. 6—Perforations 12,385 to 12,415 ft—Recovered salt water with very slight show of oil. No. 7—Perforations 11,205 to 11,230 ft—Recovered salt water.

After its thorough testing and not finding oil in commercial quantities, the well was plugged and abandoned June 1, 1947.

Elevation of the well was 178 ft. Formations were encountered at the following depths: Top Wilcox 2380 ft, top Chalk 5796 ft, top Eutaw 7219 ft, top Marine Tuscaloosa 8229 ft, top Lower Tuscaloosa 8426 ft, top Massive sand 8595 ft, top Lower Cretaceous 8921 ft, and top Anhydrite 13,515 ft.

* * *



Electric log of The Superior Oil Company's No. 1 Cassie Bradford from 12,200 ft to 15,674 ft, record depth in Mississippi.

NEWS

Ends Contract for Imports

Standard Oil Company (New Jersey) has announced the end of its contract for Middle East crude oil importations into the United States. The last shipment was carried on by the tanker Apache Canyon, which loaded on June 30 in the Persian Gulf and was cleared through United States Customs in New York, August 3. This tanker discharged about 110,000 bbl of Kuwait crude oil purchased from the Anglo-Iranian Oil Company. This cargo completes the contract made early last year when crude oil production worldwide was somewhat short of demand. The contract was made in order to assure adequate supplies of oil products regardless of the severity of last winter's weather.

Affiliates of the Jersey company have not loaded any other cargoes of crude oil in the Middle East for importation into the United States since this cargo. There are no present plans for any further importation of Middle East crude by Standard Oil Company (New Jersey) affiliates.

Receipts of Middle East crude by Jersey affiliates reached a peak of 88,377 barrels daily in February this year. These imports, which were loaded in December 1948 and January 1949, were for the purpose of supplying a high level of heating oil sales in case of a severe winter, which, however, did not materialize.

Establishes Fellowship

The Texas Company is establishing fellowships at the Texas Agricultural and Mechanical College, Duke University, and University of Virginia, company officials have announced.

Fellowships have been set up in the department of chemistry at Texas A&M, and the Virginia University. The fellowship at Duke is to encourage graduate studies in physics.

To Create Policy Council

A bill has been introduced into Congress to create a council to set up a national petroleum policy. Rep. Oren Harris (Dem.) Arkansas introduced the bill, that would set up a council to coordinate, clarify, and recommend policies to assure adequate petroleum supplies of satisfactory quality at reasonable prices for both war and peace.

Included in the council would be representatives of the Interior, State, Commerce and Military Department, and the National Security Resources Board. Where necessary, recommendations on certain legislation would be made to Congress by the council.

Set Higher Allowables

More crude oil will be produced this month, as a result of higher allowables set in several states. The Louisiana Conservation Commission set the maximum permitted output for September at 508,854 bbl daily, an increase of 6517 bbl a day over the present allowable. The order was designed to result in an estimated daily net crude oil production of 491,500 bbl. Previous oil flow in Louisiana, the third largest producing state, averaged about 483,000 bbl a day.

The Texas Railroad Commission upped the Texas September allowable 132,268 bbl daily over last month's average. Maximum production allowed is 2,077,905 bbl daily. This increase followed eight successive months of cutbacks in Texas, but the new allowable is 639,114 bbl daily below the permissible in force at the end of last December before the curtailments were started.

Kansas also came in for its share of higher allowables, with a 10,000 bbl daily increase over August. The Kansas Corporation Commission set the September allowable at 260,000 bbl daily.

Make Oral Reports

Walker T. Pound of Oklahoma, and R. R. Spurrier of New Mexico, made oral state reports before the summer meeting of the Interstate Oil Compact Commission in Estes Park, Colorado, September 1-3. This was in accordance with a policy recently established by the IOCC's executive committee whereby at least two states will make oral reports before each Compact meeting.

These two oral reports carried out the general theme of the meeting — accomplishments of the states in oil and gas conservation.

Abundant Oil Foreseen

Dr. A. I. Levorsen, dean of Stanford University's school of mineral sciences, told the U. N. Scientific Conference on conservation and utilization of resources that the United States and other free enterprise countries need not fear running out of oil in the foreseeable future.

He implied, however, that Russia and other communist or socialist countries that lack that "profit incentive" may have something to worry about. Russia declined an invitation to the conference.

The most promising regions of the world for substantial new petroleum discoveries, according to Levorsen, appear now to be the lands around the Caribbean Sea and Gulf of Mexico, the Middle East, the East Indies, and the western Canadian plains.

Study Oil Loan Further

President Truman recently told newsmen that the government is studying plans to resume negotiations with Mexico for a loan to develop Mexican oil resources. Though the President had hinted many times that such negotiations would be resumed, this is the first concrete evidence that something actually is being done on the proposed $203,000,000 loan.

After five months of talk, Mexico suddenly, on July 19, announced it was dropping its request for the loan, but hinted that it might try again later. No explanation for the action was given at that time. Throughout the long negotiations, President Truman has said he favored a loan through the Export-Import Bank.

Mexican Gasoline Prices

Gasoline prices went up one-third in Mexico City last month, with similar boosts expected shortly. According to Pemex, the Mexican government petroleum monopoly, regular 60-octane gasoline will sell for 23 cents a gallon instead of 16 cents.

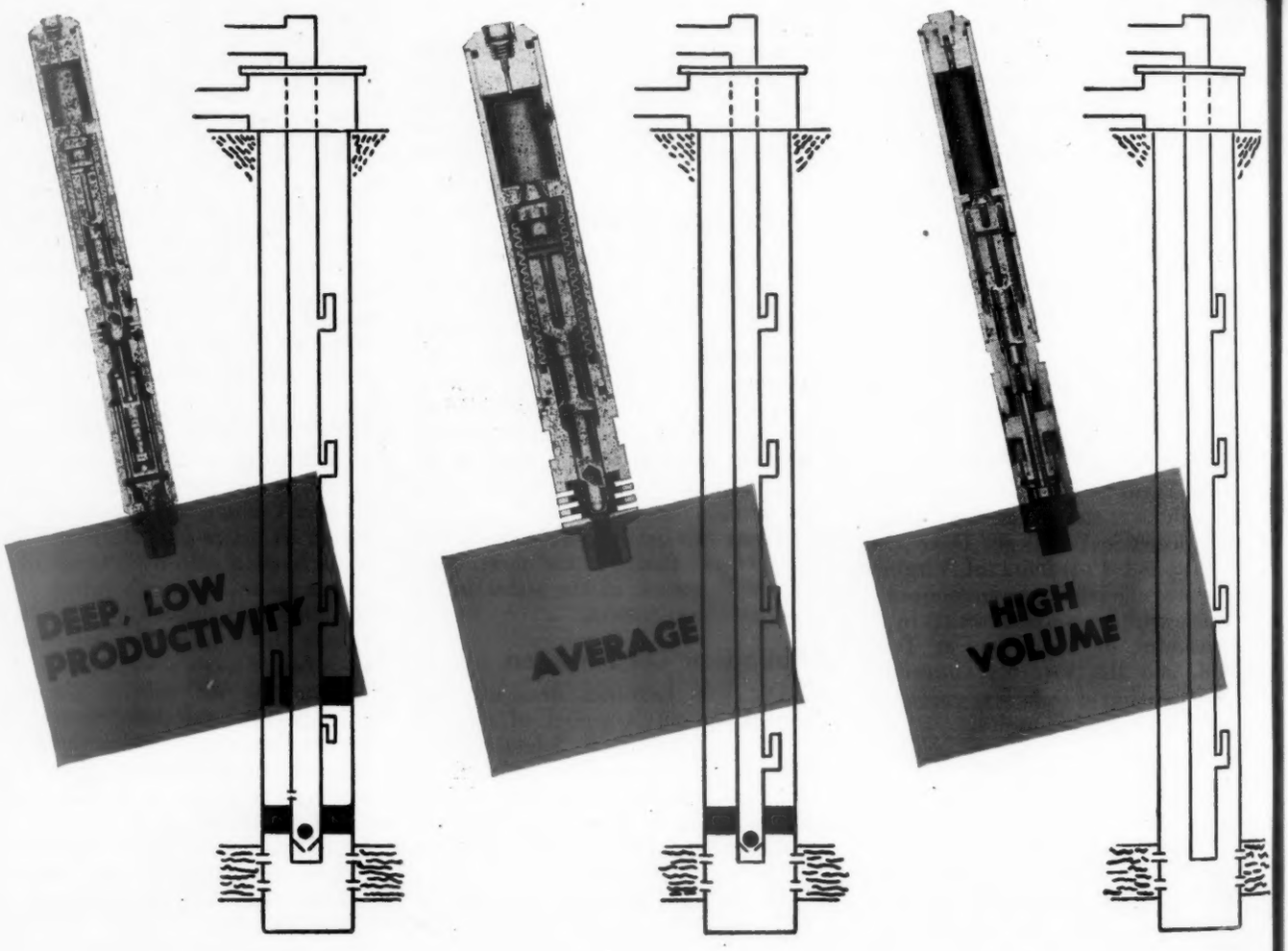
The Pemex director, Antonio Bermudez, said the price boosts are needed because of recent losses and because Pemex needs more capital to develop her oil industry. Bermudez said price industry increases for the rest of Mexico are being studied. They will vary depending on the distance from wells and refineries.

Raise Heating Oil Prices

At least two major companies have raised prices on home heating oil. Socony-Vacuum Oil Company, Inc., raised its prices of Mobilheat—No. 2 home heating oil—by 0.4-cent to 0.7-cent a gallon. Socony's prices to distributors and dealers are also being raised. Other companies are expected to follow Socony's example in raising heating oil prices. Company officials stated that prior boosts follow higher costs for the fuel at the Gulf of Mexico. In Brooklyn, New York, Socony's new price to the consumer is 11 cents a gallon, up from 10.4 cents. Last December, before five price cuts, this oil was selling for 12.9 cents.

Esso Standard Oil Company has raised its prices of home heating oil to consumers and distributors 0.3-cent to 0.6-cent a gallon. Coming on the heels of Socony's price boost, Esso's prices range slightly higher than Socony's. Esso officials stated that the company's policy, announced July 5, under which it guaranteed its heating oil jobbers and distributors the lowest price posted by it at the point of sale between the date of delivery and October 1, is still in effect.

Whatever Your Well Condition
Got-Olsco VALVE to produce



TYPE "O-BP". Pressure charged and pressure balanced, this is a large port valve upon which tubing pressure has no effect whatsoever. It is very desirable where extreme depth of lift and low operating pressures prevail . . . designed specifically for use with accumulation chambers in producing deep, low-volume wells. Chamber may be formed through use of dual packers or it may be run on tubing inside regular casing.

Ordinarily, Type "O" or "O-CF" Valves are used for unloading purposes in these installations. Surface control is provided by the GOT-OLSCO Surface Controller.

TYPE "O". Pressure charged and surface controlled, the "O" Valve provides maximum efficiency in those wells where best results are obtained in intermittent flow, with production rates ranging from 100 to 300 barrels per day. A GOT-OLSCO Surface Controller permits accurate regulation of production. Tubing packers are ordinarily used when gas lifting these wells.

For use on macaroni tubing in such wells, a "Junior" model of the "O" Valve is also available.

TYPE "O-CF". Pressure charged and controlled through a combination of tubing back pressure and injection gas volume, the "O-CF" Valve produces high volume wells by continuous flow. It operates efficiently against long flow lines and surface chokes. Valve action is completely automatic and permits uniform injection pressure from the surface to the lowest valve. It is very desirable for use with compressors in closed rotative gas lift systems.

To maintain high injection pressures at the lowest working level, "O-CF" Valves are also used for unloading above Type "O" or "O-BP" Valves.

A "Junior" model is also furnished for use on macaroni strings.

Here is the most complete line of gas lift valves in the world . . . valves that meet every producing condition and permit gas lifting any well in existence.

These valves were developed to meet well conditions . . . and each provides unequalled efficiency in a certain type well and under certain conditions. Sufficient operating flexibility is maintained in each design to provide for normal well variances and to permit selection and installation of the proper valves under estimated or approximate well conditions.

On standard installations, the tubing is left full open past the valves, permitting use of pressure bombs, paraffin scrapers and other sub-surface instruments. For use with macaroni tubing and in dual completion wells, each valve is also furnished in a "Junior" model.

GOT-OLSCO also provides **service,** with two modern plants and with experienced representatives stationed at strategic points in most active areas.

With this complete selection of GOT-OLSCO Valves, and with efficient compressor plants to furnish low cost injection gas when a natural supply is not available, there is no longer a limitation on gas lift . . . any well can now be produced by this most economical method of artificial lift.

TYPE "G". A Pressure differential, pressure-and-fluid controlled valve, the "G" Valve provides an efficient, inexpensive installation in high volume wells that can be produced at maximum rates without surface restrictions. Installed on the tubing string, they are adaptable for flowing through the tubing, or through the casing annulus.

Also furnished in "Junior" models, for use on macaroni strings.

GOT-OLSCO Gas Lift Valves provide a highly efficient and successful means of secondary recovery in dual completion wells, permitting selective production of either zone or simultaneous production of both zones in any type of dually-completed well. In these wells, two strings of pressure-charged valves may be used; or, one string of pressure-charged valves and one string of pressure differential valves.

With an efficient check valve system that prevents intermingling of fluids, GOT-OLSCO Dual Completion Installations meet full approval of regulatory bodies.

For complete information on GOT-OLSCO Gas Lift equipment and services, contact your GOT-OLSCO representative or write to our Houston office.

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ROCKY MOUNTAINS: Bettis Corporation, Casper, Wyoming. SOUTH AMERICA: C. R. Sommers, Barranquilla, Colombia.

NEWS

Gas Reserves Increase In Rocky Mountain Area

Although nearly 75 per cent of the nation's proved natural gas reserves continue to be concentrated in the southwestern states, appreciable increases were recorded in the Rocky Mountain area, particularly in Colorado and Wyoming, according to Gas Facts, the statistical record book recently issued by the American Gas Association.

Estimated proved recoverable reserves in the Rocky Mountain area advanced from 2.3 trillion cubic feet at the end of 1947 to 4.4 trillion cubic feet at the end of 1948, a gain of 91 per cent.

Of the total proved reserves of 173.8 trillion cubic feet estimated by the A.G.A. Committee on Natural Gas Reserves at the end of 1948, the Southwest area accounted for 128.7 trillion cubic feet. This figure represents a percentage gain of 5 per cent over 1947 estimates of 122.7 trillion cubic feet in this area.

Gulf Officials Meet in Canada

Directors of the Gulf Oil Company held their first official meeting outside of the United States recently, when they met in Calgary, Alta., Canada. Col. J. Frank Drake, chairman of the board and Sidney A. Swensrud, president, were in charge of the meeting.

Swensrud and Drake with other high officers of the Pittsburgh, Pennsylvania, firm were honored at a reception attended by more than 150 of the outstanding political, civic, and industrial leaders of Alberta, and Saskatchewan.

Form Oil Museum

Formation of an oil museum to be located in the original Union Oil building in Santa Paula, California, has been announced by Reese H. Taylor, president of the company. The entire ground floor of the building, the birthplace of Union Oil back in 1890, will be given over for an historical display of oil industry equipment, photographs, documents, and other material pertaining to the development of the industry in the West.

Taylor pointed out that although the oil industry in California would be 80 years old in 1950, there has been no gathering place for the historic materials used in the development of the industry.

It is anticipated that the museum will be formally opened in 1950 as a part of Union Oil Company's Sixtieth Anniversary celebration.

Oil Families Leave Canton

In the face of Communist drive, American and British oil companies are leaving Canton, capital of nationalist China. Other firms are leaving, also. Standard Vacuum Oil Company has announced that it is removing its entire staff, except for a few Chinese employees who will remain to look after the interests of the firm. The British Shell Oil Company is taking out American and British families of its staff and women employees.

Cal Tex has also evacuated families of its employees, and under present plans, only a few American employees will stay for the expected red occupation of the city.

This action came as the Communists closed in on Foochow, southeastern China port in Fukien province, and the nationalists claimed limited success on the approaches to Canton.

Commends Petroleum Advisory Board

Members of the Military Petroleum Advisory Board have been presented with letters of appreciation from Secretary of Defense Louis Johnson for their assistance in studies to meet the needs of the armed services for petroleum in an emergency.

The letters were presented for Secretary Johnson by Under Secretary of the Air Force Arthur S. Barrows, Acting Chairman of the Munitions Board, at a luncheon given for the Board by the Munitions Board Petroleum Committee.

The Military Petroleum Advisory Board is composed of 20 executives of the petroleum industry who, over the past two years, have worked closely with the military establishment on a wide range of petroleum matters. These have included studies relative to the quantities and sources of petroleum that would be available to the country in a national emergency, the synthetic production of petroleum products, refinery capacities that would be required in an emergency period, and many other studies essential to mobilization planning.

Extend Pension Plan

A pension adjustment plan designed to aid retired employees in partially meeting the effects of inflated price levels, instituted a year ago by the General Petroleum Corporation, has been extended "for an indefinite period," according to R. L. Minckler, president.

The adjustment plan means an average of $300 to each retired employee per year in addition to his regular benefits.

Raise Interests in Mexico

Further progress in the re-entry of American operators into Mexican oil fields on a contractual basis has been reported by the American Independent Oil Company de Mexico, S. A. Ralph K. Davies, president, announced that his company plans to spud in the first two wells by October 1.

Davies also stated that American Independent has increased its interest in the Mexican venture to 53⅓ per cent of the total, from 33⅓ per cent originally held. Signal Oil and Gas Company de Mexico, retains its original 33⅓ per cent interest while Edwin W. Pauly, third member of the American contracting group, retains a 13⅓ per cent interest.

Other American firms interested in exploring and developing Mexican oil include: J. S. Abercrombie, Houston, Texas; Ashland Oil and Refining Company, Ashland, Kentucky; Hancock Oil Company, Long Beach, California; Phillips Petroleum Company, Bartlesville, Oklahoma; Signal Oil and Gas Company, Los Angeles, and Sunray Oil Corporation, Tulsa, Oklahoma.

To Discuss Fire Prevention

Mechanical foam fire protection will be discussed by the central committee on fire protection of the American Petroleum Institute's Department of Safety at the API annual meeting next November.

The program will be in the form of an afternoon panel discussion, in which outstanding fire protection engineers of the industry will participate. The API annual meeting will be held in Chicago November 7-9, inclusive.

Make Manpower Survey

More than 25,000 copies of a questionnaire have been sent out by the National Petroleum Council, in its national survey of the manpower needs of the petroleum industry. Every company in the oil industry will receive copies of the questionnaire, according to W. W. Vandeveer, chairman of a special committee appointed by the NPC to make the survey.

Survey forms have been divided into five separate classifications: Exploration and production, manufacturing, pipe line transportation and supplies, shipping and distribution, and general management.

Replies to the industry-wide questionnaire will be turned over to the National Security Resources Board, which is making a study of the manpower needs of important industries in the event of another war.

OIIC Prepares Bulletin

A manual containing directions and procedure for holding open house has been prepared for oil companies by the Oil Industry Information Committee.

Titled "Holding Open House," the manual contains 20 pages and cover and has complete suggestions as to the various groups who might be invited to attend, and an explanation of the various activities that a company holding open house might wish to undertake to assure making the event a success.

Prints of the OIIC's motion picture, "The Last Ten Feet," are being distributed currently to the district offices of the OIIC and to the many oil companies and associations that purchased them for their own libraries.

Special showings of the 16 mm sound movie will be one of the features of Oil Progress Week, October 16-22, when the industry makes a direct report to the people of the nation in virtually every community in the land.

Add 36 Scholarships

Standard Oil Company of California has announced sponsorship of 36 new scholarships for the 1949-50 academic year in nine public universities. Four undergraduate awards, for $500 each, have been given to the Universities of Alaska, Arizona, California (two at Berkley and two at Los Angeles), Hawaii, Idaho, Nevada, Oregon, Utah, and Washington.

While selection of the winners will be entirely in the hands of the universities, Standard is suggesting that they be chosen primarily on the basis of potential future leadership. Standard's only restriction is that they be granted to men or women regardless of course of study or race or creed.

Store Oil in Mines

Abandoned feldspar mines have been put to good use in Sweden. The Swedes are now storing oil in the old mines, considered almost completely proof against atomic bombing.

The Stockholm Tidningen, has reported that two abandoned mines near the capital have been converted to take the capacity of 14 oil tankers. The oil is pumped in right out of the ships, settling over some feet of salt water. Copper heating coils have been installed to keep the oil viscid during severe Swedish winters.

The Swedish newspapers also report that use of other abandoned mines for storage of important liquid fuels is being investigated by the government. The country's only native source is from oil shales which yield about 100,000 tons of gasoline a year.

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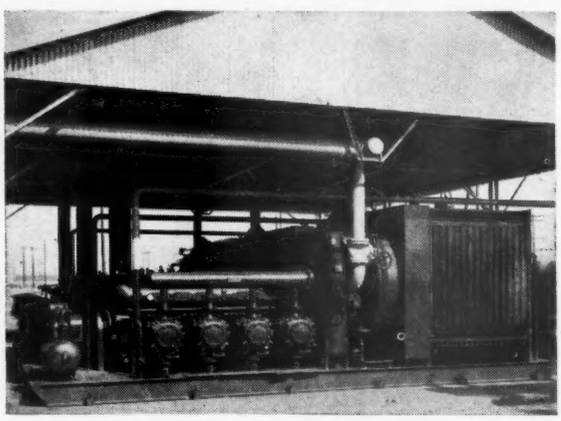
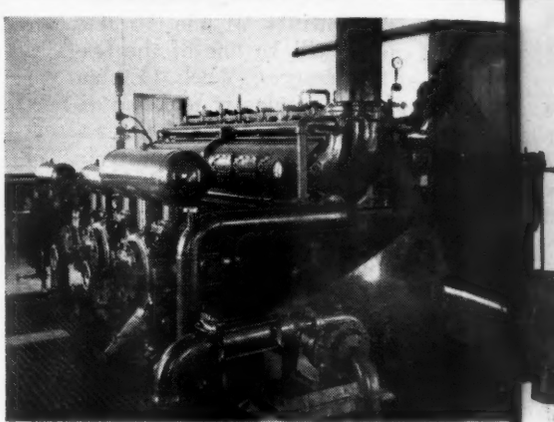
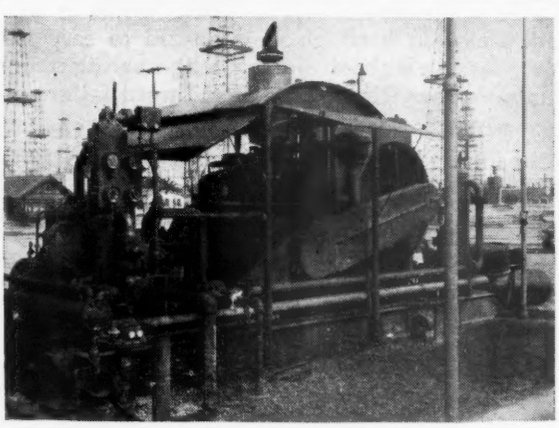


Three Clark Midget Angle 4-cylinder units, used for gas booster service at the Pacific Lighting Corporation, Wilmington, Cal.

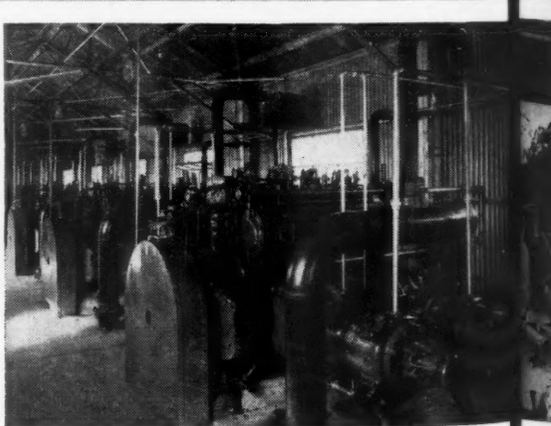


Clark Midget Angle 8-cylinder stationary units, used by the Union Oil Co., Lompoc, Cal., for gas booster service.

GATHERING FIELD GAS



Skid-mounted Midget Angle used for gathering field gas by Long Beach Oil Development, Long Beach, Cal.



Five stationary-mounted 4-cylinder Midget Angles at Consolidated Gas Utilities Company, Magic City, Texas.

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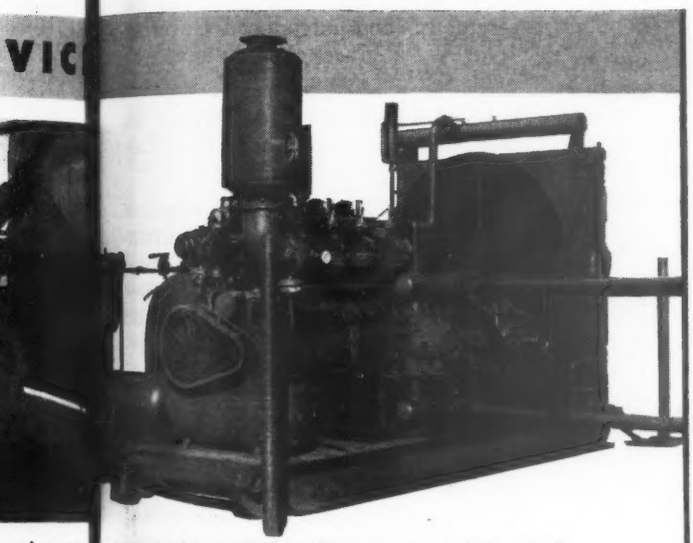

El Paso Natural Gas Company uses this Clark 4-cylinder semiportable MA unit for gas booster service at Jal, N. M.

These typical installations . . . only a few of hundreds throughout the industry . . . *prove* the versatility of Clark Gas-Engine-Driven "Midget Angle" Compressors.

For permanent installations, the "Midget Angle" cuts costs by occupying small floor space with light foundations. Mounted on skids, it is an ideal semiportable "packaged" compressor for short-duration jobs in the field.

Operating costs are low. Operation is practically automatic—one or two men can easily handle several stations.

Clark "Midget Angles" are available in 2, 4, 6 and 8 cylinder units, developing from 75 to 300 B.H.P. For further information call your nearest Clark Bros. office, or write for descriptive booklet.

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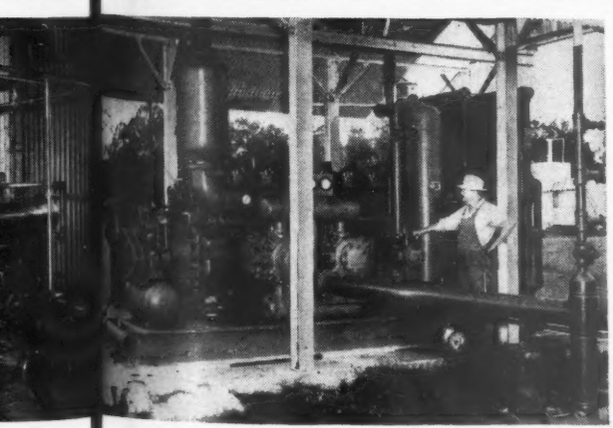
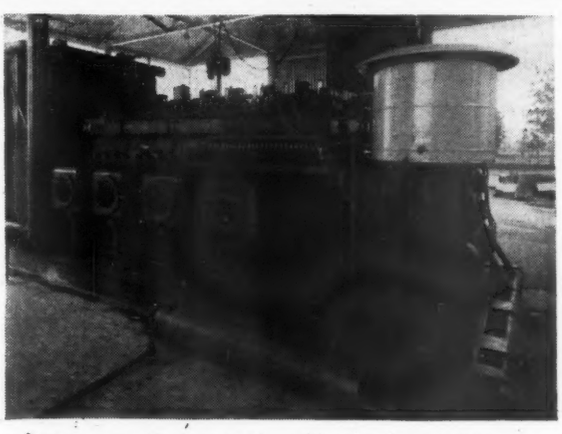
GAS LIFT



Skid-mounted Clark Midget Angle in gas lift service for the Atlantic Refining Co., Harden Field, Texas.

REPRESSURING



Two 8-cylinder Midget Angles used in repressuring residue gas back into producing sands—W. T. Burton Co., Stark, La.

...E "ANGLE" COMPRESSORS

PERSONALS

T. V. Moore, of Standard Oil Development Company, New York City, and **H. G. Vesper,** of California Research Corporation, San Francisco, have been appointed chairmen of two American Petroleum Institute advisory committees on fundamental research, it was announced by Robert E. Wilson, chairman of Research Committee of the API Board of Directors.

Wilson disclosed the inauguration of a new plan for the biennial rotation of the advisory committee chairmanships.

Moore succeeded **Earl G. Gaylord** as head of the advisory committee on Fundamental Research on the Occurrence and Recovery of Petroleum, and Vesper succeeded **W. J. Sweeney** as chairman of the Advisory Committee on Fundamental Research on Composition and Properties of Petroleum.

Lloyd F. Thanhouser, prominent corporation attorney of New York City, will become general counsel of Continental Oil Company, effective October 1, it was announced by L. F. McCollum, president.

It was also announced that **Burney Braly,** formerly general attorney for Continental, with offices at Fort Worth, has been appointed associate general counsel, also effective October 1. Thanhouser will succeed James J. Cosgrove, who has been general counsel since 1929 and who will devote his time to his duties as chairman of the board of Continental Oil.

Now a resident of Great Neck, Long Island, and a partner in the New York law firm, Satterlee, Warfield and Stephens, Thanhouser has specialized for several years in corporate work and civil litigation. He received his Ph. B. and LL. B. degress from Yale University and was admitted to the New York Bar in 1926.

Braly, who was born at Minden, Texas, received his law degree from Cumberland University, at Lebanon, Tennessee. He joined Continental in 1926 and became general attorney for the company at Fort Worth in 1928.

Appointment of **D. A. Shock** to the position of senior research chemist in charge of the production chemistry group in Continental Oil Company's production laboratory has been announced by H. H. Hinson, chief production research engineer. Shock resigned from the research staff of the University of Texas at Austin where he had been in charge of corrosion research problems, including those sponsored by the Natural Gasoline Association of America.

Before his work at the University of Texas, he had been employed by International Minerals and Chemicals Corporation, Austin, and Dow Chemical Company, Midland, Michigan. He is a member of the National Association of Corrosion Engineers and The American Chemistry Society.

Shock is a chemical engineering graduate from Colorado College, Colorado Springs, Colorado, and obtained his master's degree in chemistry from the University of Texas.

H. M. Stalcup, 66, retired vice president of Skelly Oil Company, died recently in Bentonville, Arkansas.

Stalcup joined Foster Oil Company in 1917. His work with Foster touched upon all branches of oil producing as the company centered its activity in the Homer and Bull Bayou fields of Louisiana and in Oklahoma and Kansas.

In 1923 he joined Skelly Oil Company as executive assistant. He was made vice president in charge of oil production and natural gasoline manufacturing in May, 1923.

William K. Whiteford, president of British American Oil Company, Ltd., Toronto, Ontario, Canada, was recently elected to the board of directors of Canada Life Assurance Company.

C. L. Butler, formerly chairman of the board of directors of Roosevelt Oil and Refining Corp., Mount Pleasant, Michigan, has been named president of the company. He succeeds **A. W. Winter,** who resigned. **C. L. Maguire,** former president of Roosevelt Oil Company, a predecessor of Roosevelt Oil and Refining, was elected a director.

J. Elmer Thomas, 57, oil man and geologist, was found dead in his hotel room in Fort Worth, Texas, recently.

Justice of the Peace Whit Boyd returned an inquest verdict of death from natural causes.

Thomas had returned last month from Italy, where he was investigating oil reserve of the Po Valley for the Italian Government.

He had been connected with the Federal Government for more than a decade. He served from October, 1941, to June, 1943, as special assistant to Deputy Petroleum Coordinator Ralph K. Davis.

Leban E. Harmon, Standard Oil Company (Indiana) has been elected chairman of the advisory committee for the American Society of Corporate Secretaries, Chicago, Illinois chapter.

W. O. Twaits, former manager of the coordination and economics department, Imperial Oil, Ltd., Toronto, has been transferred to the producing department, western division, at Calgary, Alta., Canada., in the capacity of management assistant. Twaits joined the company's manufacturing department in 1933.

O. C. Schorp, president, and **T. R. Corbett,** manager of manufacturing, Carter Oil Company, Tulsa, Oklahoma, were among those officials attending the formal opening of the company's new refinery at Billings, Montana recently. Schorp gave an address before the group attending the ceremony, and introduced Governor John W. Bonner of Montana, who made the keynote address.

Forest L. Fry, superintendent for Noble Drilling, has moved from Casper to Moorcroft, Wyoming.

Douglas Ball, petroleum engineer specializing in gas-reservoir mechanics, gas production, seismic exploration, and pipe line operation, is now associated with Max W. Ball, oil and gas consultant in Washington, D. C.

Walter S. Hallanan, chairman of National Petroleum Council and president of Plymouth Oil Company, will be the principal speaker at the annual convention of the Louisiana-Arkansas division, Mid-Continent Oil and Gas Association in New Orleans, Louisiana, September 22-23. He will speak at the annual banquet held September 22.

B. W. Kemper, Donald G. Kendall, and **William A. Howell, Jr.,** have formed the Westmont Oil Company, in Los Angeles, California. They will search for oil in the Los Angeles Basin area.

Roy J. Turner, governor of Oklahoma, has written a new song, titled, "My Memory Trail," which was recently presented by the Cities Service "Band of America" under the direction of Paul Lavalle. The song was written aboard the inaugural train of President Truman.

Before his election as governor, Turner was active in the oil and cattle businesses in Oklahoma. The motion picture "Tulsa" was filmed on his 10,000-acre ranch near Sulphur, Oklahoma.

Riser Everett, Carter Oil Company, Oklahoma City, has been elected president of the Oklahoma City Geological Society. Other officers include R. L. Roberts, Vickers Petroleum Company, vice president; Larry Curtis, Sohio Petroleum Company, secretary; and Joe Sears, consulting geologist, treasurer.

PERSONALS

Roy J. Barnett, tax commissioner of Standard Oil Company (Indiana) retired on company annuity August 9 after 29 years' service. Barnett joined Standard in 1920 after serving as a member of an accounting firm, and later with the income tax division of the U. S. Treasury department. Barnett is a member of the National Association of Assessing Officers, National Tax Association, Tax Institute, and revenue and tax committees of the Illinois State Chamber of Commerce and Chicago Association of Commerce and Industry.

James W. Templeton of Houston has been promoted to assistant general auditor of The Texas Company. He has been with the company for 26 years.

Walter J. Levy has resigned as chief of the petroleum branch of the Economic Cooperation Administration to enter private business as economic consultant with headquarters in New York.

Levy has been chief oil official for ECA for the past year. He will act as special oil consultant to Paul Hoffman, ECA administrator, until a new director is named.

Frederick C. Loomis

Frank L. Frick

Frederick C. Loomis has been appointed oil purchase and exchange agent for Standard Oil Company of California, T. S. Petersen, president, has announced. In the newly created position, Loomis will centralize activities previously carried on by a number of departments. He will be in charge of all the company's oil purchase and exchange negotiations and agreements.

Frank L. Frick will assist Loomis. Loomis was graduated from Stanford University in 1923 and his service with Standard dates to 1924. He held a wide variety of positions in the company's natural gasoline operations until 1934 when he became a specialist in the department on organization. In 1945, he was made assistant manager of the natural gasoline department. Frick has been with Standard since 1921.

George S. Dunham has been appointed vice chairman of the manufacturing committee of the Socony-Vacuum Oil Company, Inc., it was announced recently. Dunham will supervise operations of the company's eastern and mid-west refineries and pipe lines.

He succeeds **Douglas L. Hooker,** who has retired from active service with the company.

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PERSONALS

▸ **James H. Pipkin,** assistant to the president of The Texas Company since 1944, has been named assistant to the chairman of the Board, it has been announced. **J. T. Wood, Jr.,** former division manager, Pacific Coast division, producing department, has been made assistant to the president. **E. R. Filley,** manager of the producing department, has been promoted to general manager of that department, and **J. H. Puls,** assistant division manager, Pacific Coast division, succeeds Wood as division manager.

Pipkin received his Bachelor of Law degree from the University of Texas in 1931. After a period of legal work in and around Beaumont, Texas, he took a position in The Texas Company's Legal Department at Houston in 1934. He was made assistant to the executive vice president and transferred to New York in February, 1942, and two years later became assistant to the president.

Wood was graduated from Stanford University in 1918 after service in World War I. He was first employed by The Texas Company in 1929 as a district geologist in the San Joaquin Valley, California. In 1930 he was made assistant chief geologist with headquarters at Los Angeles, and in July, 1931, became chief of the lands and leases division. Later, he was appointed assistant manager and, in July of 1938, division manager of the Pacific Coast division.

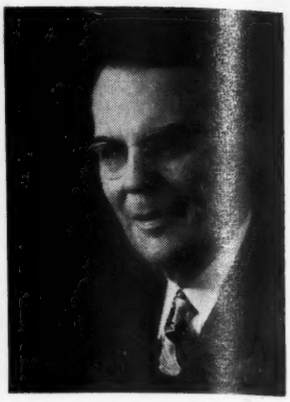
Filley, born in Nebraska, is a graduate of Baker University, Baldwin, Kansas. He entered the service of the Producers Oil Company, a Texaco subsidiary, in 1914, and was made chief clerk of the land department in February, 1917. Two years later he became secretary to the late Colonel Wilson, general superintendent, Oklahoma-Kansas division, producing department. He became assistant manager of the department at Houston in March, 1938, and became manager in April, 1947.

Puls was graduated from California Institute of Technology in 1923, and entered the service of the California Petroleum Company, later The Texas Company (California), in 1925. He worked as a design engineer and chief draftsman in the refining department, and in 1937, was transferred to the producing department as an engineer.

▸ **H. M. Horton,** formerly with Superior Oil Company of California in Colombia and Venezuela, has resigned and returned to Mount Carmel, Illinois, as an independent operator.

Philip C. Dixon

G. M. Vandaveer, Jr.



W. H. Blackburn

▸ Midstates Oil Corporation, a subsidiary of Middle States Petroleum Corporation, has announced the election of three new vice presidents. **Philip C. Dixon,** oil and natural gas engineer, of Houston, Texas, has been made executive vice president. **George M. Vandaveer, Jr.,** and **W. H. Blackburn,** both of Tulsa, Oklahoma, also become vice presidents. The new officers will all have headquarters at Tulsa, Oklahoma.

Dixon, after graduation from the Colorado School of Mines, became a member of its faculty as Professor of Petroleum Engineering. He later established a consulting engineering practice at Houston, Texas.

Vandaveer will be vice president in charge of production and engineering. He has successively headed Midstates' engineering and production departments since 1940, after 15 years of earlier association as engineer with Midwest Refining Company, Stanolind Oil and Gas Company, E. H. Moore, Inc., and Phillips Petroleum Company, following his graduation from the University of Wyoming.

Blackburn has been associated with Midstates in managerial capacities since 1919, working closely with N. T. Gilbert, of Tulsa, former executive vice president, recently deceased.

Joseph Glass of New York, continues as president and **Frank H. Harrell,** of Shreveport, Louisiana, continues as senior vice president.

▸ The Gulf Oil Corporation has announced the voluntary retirement from active duty of **Donald G. Clark** because of ill health. Clark has been director of purchases of the Gulf companies since 1939. He will continue to act in an advisory capacity.

The position of director of purchases is being discontinued. **Lee C. Bock,** who has been general purchasing agent since August 1, 1946, will be in charge of purchases for all Gulf companies. Bock has been with Gulf for some 38 years.

▸ **R. G. Shanklin** has been appointed manager of petroleum products, retail merchandising department, Socony-Vacuum Oil Company, Inc. He was formerly division marketing assistant for motor oils and specialties in the company's Albany, New York, division.

Classified

WANTED

Midwestern manufacturer seeks man with engineering background experienced in the sale of equipment to oil industry. Familiarity with internal combustion engines desirable. State qualifications, age, and compensation required in first letter. Write Box 105, The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

Two young ex-service pilots—clean cut appearance—three years college—unmarried—free to travel—domestic or foreign. Extensive sales and business experience—current valid CAA instrument ratings and Commercial pilot certificates (single and multi-engine land and sea)—familiar all types aircraft. Desire positions as personl pilots and business aids—excellent references. Refer inquiries to Box 102, The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

MECHANICAL ENGINEER

Thorough university background followed by five or more years of outstanding achievement a definite requirement. Must have creative ability, a precision-technical mind. Men of less ability should not make inquiry. Salary commensurate with rigid requirements. A Missouri corporation. Correspondence confidential. Box 104, The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

CORROSION MAN

Must have broad thorough technical education, not less than five years of successful experience. Requirements stiff. Salary in keeping with ability. Box 103, The Petroleum Engineer, Box 1589, Dallas, Texas.

OIL and GAS TRADE NEWS

New Plant Opened

Baash-Ross Tool Company has recently opened its new plant and offices in Oklahoma City, Oklahoma.

The new plant is built directly over the original Baash-Ross plant, established almost 20 years ago, and the old plant was then dismantled from underneath the new plant. This enabled sales and manufacturing of Baash-Ross equipment to be carried on without interruption from the old plant while the new and larger plant was being completed around it. Even the new machine tools and production equipment were installed and in operation before dismantling of the old plant was initiated.

The new plant contains over 20,000 sq ft of floor space and has a main bay with a 50-ft clear span and 320-ft travel serving plant and storage yard equipped with a 5-ton overhead electric traveling crane.

The new Baash-Ross Oklahoma City plant will also serve as warehouse and office headquarters for the entire Northern Mid-Continent area. Carried in stock for immediate delivery are the many items that make up the complete Baash-Ross line.

Join T.E.M.A. Group

J. E. Hughes, manager of the heat exchanger division of Western Supply Company, Tulsa, Oklahoma, has announced the election of the company to membership in the Tubular Exchanger Manufacturers Association.

T.E.M.A is a group of manufacturers serving the refining, gasoline, and general processing industries. This group is responsible for the development of thermal and mechanical standardization of tubular heat transfer equipment.

Factory Branch Opened

J. F. Ray, vice president in charge of sales, for the General Controls Company at Glendale, California, recently announced the opening of a new factory branch office in Cincinnati, Ohio, to service southern Ohio, southeastern Indiana, and central Kentucky. This new office will be headed by Jack Prutow, branch manager.

Ray also reported the moving of their Oklahoma City office to Tulsa. This transfer was made in order to improve service facilities to the petroleum and allied industries in that area. O. D. Shaddox will continue as branch manager in the new location.

Appoint Representatives

Davey Engineering Sales Company of St. Louis, Missouri, has been appointed to represent United Centrifugal pumps in that territory, according to an announcement issued by United's executive offices in Oakland, California. Kingsley "Lee" Davey, head of the St. Louis firm, is a registered professional engineer of the State of Missouri. Prior to his establishment of the present St. Louis organization, he served as a pump design engineer for Darling Brothers.

United Centrifugal Pumps is a division of United Iron Works, founded in 1880. For the past 30 years they have specialized in engineered-to-the-job pumps for pipe line, refinery, and processing applications.

Acquires New Shut-Off Valve

Harry Roberts, Jr., owner of the Roberts Pipe and Supply Company, Houston, Texas, has announced that his company has acquired manufacturing and sales rights for the Automatic Shut-Off Valve, from its inventor, R. E. Meynig. This valve is being used by the oil industry as a safety factor on flow lines to protect against commodity loss or damage.

Known as the Roberts Automatic Sut-Off Valve, this valve automatically closes against any pre-determined high or low pressure. If pressure builds up in the line beyond the valve, it will automatically shut off the flow. Also, if a break or leak occurs in the line, the drop in pressure will cause the valve to close.

Roberts started his pipe and supply business following discharge from the Navy. For seven years he was with the Gulf Oil Corporation, in Venezuela.

Forms Canadian Company

M. O. Johnston, pioneer oil man and oil tool manufacturer, has formed the M. O. Johnston Oil Field Service, Ltd., with headquarters at Edmonton, Alberta, to serve the expanding needs of Canadian operators. Joe Barlow has been appointed manager. The establishment of Canadian facilities makes a total of 35 Johnston service locations.

M. O. Johnston

Add New Stores

Three new branch stores to serve Eastern New Mexico, North Texas, and Western Louisiana have been opened recently by Waukesha Sales and Service Company, Louis M. Pearce, Jr., vice president of Waukesha Sales and Service, Houston, has announced.

The new branches are located at Hobbs, New Mexico, Wichita Falls, Texas, and Shreveport, Louisiana. The Hobbs branch will stock Waukesha engines and parts. Wichita Falls and Shreveport branches will provide complete service facilities in addition to complete stocks of Waukesha engines and parts, Pearce said.

F. A. Chance is branch manager of the Shreveport branch. S. W. Wacey is manager of the Wichita Falls branch and Tom Gatewood is branch manager for the Hobbs store.

Superior Iron Works and Supply Company, Inc., recently opened a new supply store in Lafayette, Louisiana. O. C. Johnson is store manager.

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If it's hot, your profits are leaking away — you need
TWECO REDHEAD Ground Clamps

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Distribute Paris Products

Henry H. Paris, president of Henry H. Paris Distributor Inc., of Houston, Texas has announced the appointment of Swan Specialties Company of Casper, Wyoming and Edmonton, Alberta, Canada, as distributors of their products in the Rocky Mountain area and Southwest Canada. Swan Specialties will represent Henry H. Paris Distributor Inc., for the sale and distribution of the following oil well and refinery supplies Western safety barrel stand, oil country tubular products; Harrisburg steel flanges and seamless casing and line pipe couplings; volcano burners; OSECO plugs and Dresser welding ells.

Increase Personnel

Motorola, Inc., is hiring 1000 additional workers, bringing the total to over 4500, the highest number of radio and television employees in the history of the firm, Paul V. Galvin, president of the company, announced.

Motorola's hiring of new employees has been made necessary in order for Motorola to achieve all-out production of its new 1950 line of television and radio sets being introduced this fall.

On July 11 Motorola opened a new television plant, an increase in the company's over-all television production facilities of over 40 per cent. These are the facilities which the newly-hired workers will help to keep at full-scale production. Earnings for the past six-months increased nearly $7,000,000 over the corresponding figure for 1948.

To Open Branch Store

A new branch sales store of U. S. Steel's Oil Well Supply Company will be opened about September 23 at Lake Charles, Louisiana, F. D. Smith. Gulf Coast Division manager, announced.

"The new store in this area will enable 'Oilwell' to better serve the supply needs resulting from increased oil activity in southern Louisiana and off the Louisiana coast," Smith said.

Construction has already begun on the building which will house the new store.

Establish New Department

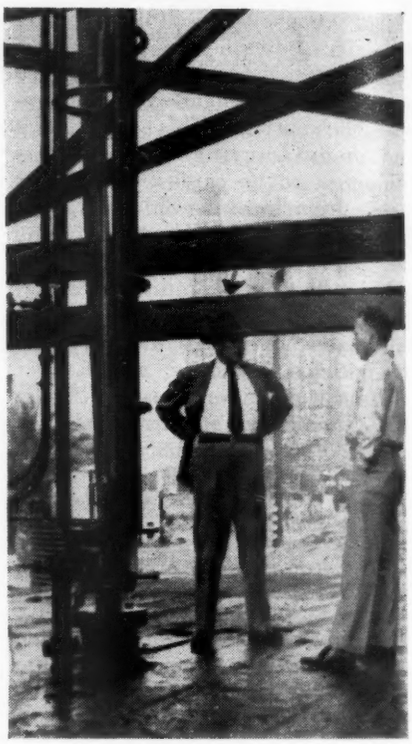
Frank Purnell, president of The Youngstown Sheet and Tube Company, issued the following release recently:

The Youngstown Sheet and Tube Company is establishing a department of public relations, which is a new division. Stuart D. Goulding will be in charge of the department as director of public relations. His office will be located in the Stambaugh Building.

Opens New Office

The Continental Supply Company has opened an office in Kansas City, Missouri, in the 12th and Walnut Street Building. D. L. Smith is the manager.

This office will be under the supervision of R. A. Brewer, district manager, Tulsa, Oklahoma.



View Pumping Installation

O. G. "Blackie" Houser, above left, sales manager for the petroleum equipment division of Vickers Incorporated, hydraulic controls pioneers, looks over one of its early model pumping installations at Santa Fe Springs in California with George Vickers, who is in charge of installations and service, prior to his leaving on a trip through the Mid-Continent area, Dallas, Tulsa, and then on to Detroit, Michigan for a conference at the home office.

Ideco Store Opened

T. D. Collins, vice president Ideco Supply Stores Division, has announced the opening of a new Ideco oil field supply store located at Lafayette, Louisiana. George Fox has been appointed as store manager. This new installation will be operated under the direction of the Louisiana district manager, J. L. Morgan.

J. W. Terrell and Jimmie Norton, Ideco sales representatives, have been transferred to the Lafayette area and have established headquarters at the new supply store.

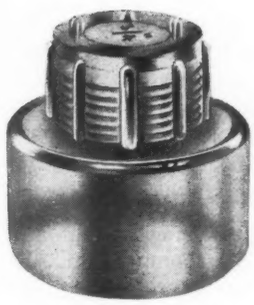
this corroded stud

FORCED A COSTLY COMPRESSOR STATION SHUT-DOWN!

After only 14 months of service this high tensile stud was cut from a 24" header flange on the outlet of a gas cooling tower because corrosion had made it impossible to tighten the flange and stop the gasket leak.

This shutdown was very serious and most costly. The danger and inconvenience could have been averted by installing Maloney Stud and Bolt Protectors at the time of original assembly.

The Maloney Stud and Bolt Protectors are made of molded transparent polystyrene plastic which affords instantaneous visual inspection and may be obtained in the following transparent colors: blue, red, amber, and green. This selection of colors affords perfect tie-in with safety colors and adds greatly to the dress-up of the plant.



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MALONEY plastic stud and bolt protectors

provide complete protection at all times against salt water, acid fumes and weather!

The protectors are not affected by corrosive action of weather, gas fumes, salt water, acid fumes, oil or the elements.

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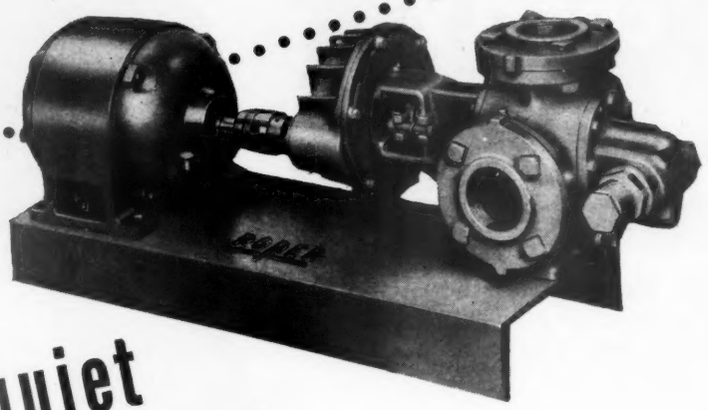
PUMPS for CLEAN LIQUIDS

thick or thin.....



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efficient
dependable

The Roper, 3600 Series, Pump illustrated above is a motor-driven unit with totally enclosed anti-friction gear reduction, mounted on a steel bedplate. Furnished with or ready to receive a standard motor. Capacities from 40 to 100 g.p.m. Other models in double and multiple units also available.

Roper motor-driven pumps are highly efficient for pumping oils, greases, solvents, thinners, paints, syrups, etc., in industrial plants and process industries. They handle a wide range of thick or thin clean liquids efficiently, quietly, economically.

Roper dependability is assured by design simplicity and time-proved features such as self-lubrication, extra deep packing box, adjustable relief valve, anti-friction shaft and thrust bearing, axial hydraulic balance, etc.

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ROCKFORD, ILLINOIS

SEE OUR CATALOG IN SWEET'S

ROPER
Rotary Pumps

Kobe Announces Changes

Kobe, Inc., has announced the division of the West Texas area into two sales districts. K. D. Snedeker, one of the Kobe men in West Texas and formerly assistant manager of the combined districts, has been made manager of the West Texas-Brownfield district. Two representatives assigned to the district are Ray R. Swanke and G. T. Byer.

Announces Opening

J. L. Shakely, president, Jones and Laughlin Supply Company, announces the opening of their new store in Edmonton, Alberta, Canada, and a district sales office in Calgary.

H. L. Wilkins

This new area will be under the management of H. L. Wilkins, who was appointed manager of Canadian Operations effective July 1. Wilkins has been in the oil field supply business over 30 years, having started at Nelagony, Oklahoma, store in 1919, as salesman, later serving at other points in various positions.

Plan New Ammonia Plant

Plans for the construction of a five million dollar ammonia plant at Freeport, Texas, have been announced by Leland I. Doan, president of The Dow Chemical Company. The plant will have a capacity of approximately 100 tons per day.

Field construction is expected to start about January 1, Doan said, and it is anticipated the plant will be in operation late next year. The plant will utilize hydrogen available from the company's huge chlorine plant there and combine it with nitrogen from the air to form anhydrous ammonia. Doan described the process as the Haber-Bosch process used in production of ammonia at Dow's Michigan and California locations, and he also stated it would employ 1000 hp gas engines for compression of the air and hydrogen.

TRADE PERSONALS

▸ **A. J. Kerr,** Pittsburgh, Pennsylvania, and **H. S. Rockwell,** Hopewell, New Jersey, both executives of the Rockwell Manufacturing Company spent August in Europe, studying European manufacturing and production methods, appraising current export sales conditions, and visiting several of the plants in European countries which are paying royalties and engineering fees to Rockwell Manufacturing Company.

Rockwell, vice president and general manager of the company's Hopewell division, spent a good portion of his time reviewing Swiss methods of precision production of small parts.

Kerr, vice president of sales, studied valve and meter manufacture both in England and on the Continent.

▸ **E. M. Frye** has been appointed manager of the newly created Dallas district sales office, according to a statement recently issued by Don L. Collins, executive vice president and general manager of sales for Republic Supply Company. Frye has been with Republic Supply since November 1943, serving until now as field representative in Dallas, Texas. His previous business connections were with Norvel-Wilder and Frick-Reed corporations.

▸ **John E. Stukel Jr.,** former assistant professor at Carnegie Institute of Technology, Pittsburgh, Pennsylvania, has joined the operating department of The Youngstown Sheet and Tube Company as a development engineer. Stukel is working at present in the office of Karl L. Fetters, special metallurgical engineer, in Youngstown, Ohio.

▸ Appointment of three American Steel and Wire Company sales officials to newly-established posts of area managers of sales have been announced.

The three areas set up under the new territorial plan cover all sales districts served by the company. The three area managers who will be located at New York, Cleveland, Ohio, and Chicago, Illinois, will report directly to H. M. Francis and John Graham, the company's general manager of sales. The appointments were effective August 1.

Named to the post of Eastern area manager of sales, with headquarters in New York, was **Roswell F. Curtis,** since 1945 the manager of the company's manufacturers' products sales division. Appointed to a similar post for the Central area, with headquarters in Cleveland, was **Howard B. Maguire,** the company's sales manager at Detroit since 1933. Named Western area manager of sales, with headquarters in Chicago, was **Clarence T. Gilchrist,** Chicago sales manager from 1937 to 1945 and since that date assistant general manager of sales for the Chicago district.

▸ **A. K. "Deacon" Brown** and **Jack Long,** mud engineers for Oil Base, Inc., have returned to the head office at Compton, California, for an extensive training course in White Magic, the new oil-emulsion mud for top-hole drilling now under test. Brown and Long will help supervise and record results of these experiments. Brown represents the Rocky Mountain area.

▸ **H. Vernon Smith,** former chief engineer of the Houston, Texas, plant of Parkersburg Rig and Reel Company, is new general manager of Rolo Manufacturing Company, Houston.

The new Rolo manager succeeds W. A. Swan who has moved from Houston to the Rocky Mountain area to manage the company's business in that section as well as Rolo, Ltd., of Canada.

A native of Chickasha, Oklahoma, Smith received a petroleum engineering degree from the University of Oklahoma in 1940.

▸ The appointment of **Edward Hurlburt** as manager of consumer advertising, and **Walter E. Schutz** as manager of industrial advertising of the power tool division of Rockwell Manufacturing Company has been announced by Robert P. Melius, Rockwell vice president in charge of power tool sales. **Fran Hopp** has also been appointed assistant manager of industrial advertising. All will make their headquarters in Milwaukee, Wisconsin.

Hurlburt has been advertising manager of the Ritter Company, Rochester, New York, since 1942. Schutz has been advertising manager of the Delta Manufacturing Division of Rockwell for a number of years. Before joining Delta, he was active in the typographic field in Milwaukee.

Dave Meddick

▸ **Dave Meddick,** formerly chief production engineer with Lane-Wells, technical oil field service firm, has been appointed superintendent of the Eastern Division for Petro-Tech, according to an announcement made by Keith Miner, vice president of Petro-Tech. Petro-Tech is the Venezuelan subsidiary of Lane-Wells.

Meddick had been with Lane-Wells in an engineering capacity since 1937, prior to this appointment. He has made major contributions to the design and development of several Lane-Wells products.

▸ Fairbanks, Morse and Company, announce the appointment of **Frank M. Mason, Jr.,** as director of engineering. He will continue to be located at the firm's headquarters office, Chicago, Illinois.

Mason, who has for several years been manager of the research division in charge of all research, developments, and patents, joined the company in 1922 following his graduation from Northwestern University, the Massachusetts Institute of Technology, and Washington University.

▸ **Byron W. Cain** has been appointed to the newly created office of assistant comptroller by The Continental Supply Company, it was recently announced by F. M. Mayer, president. He will be situated in the company's Dallas, Texas general headquarters.

Previously identified with the oil industry as an accountant for the Carter Oil Company, Tulsa, and as district office manager for the Creole Petroleum Company in Carpito, Venezuela, Cain started with Continental in February, 1948.

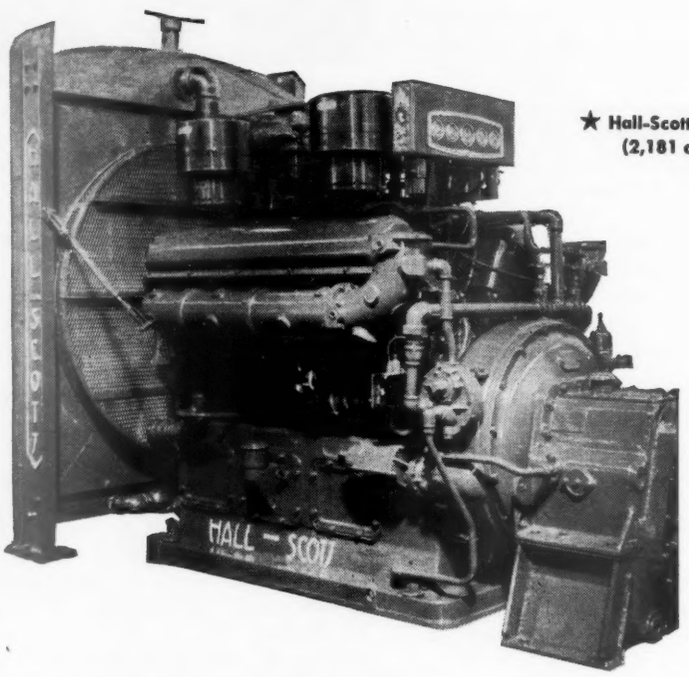
▸ **Harry A. Dennis** has been made manager of sales of the Weldment division in the Midwestern area, for Graver Tank and Manufacturing Company, Inc., East Chicago, Indiana. Dennis was formerly with Lukens Steel Company and their by-products and Lukenweld divisions as assistant district manager of sales.

Starting in 1939 with the Lukens Company as a helper in the open hearth, Dennis later became a welding research engineer and for several years did welding service engineering work. He obtained a degree in metallurgy at Pennsylvania State College.

▸ The Continental Supply Company has announced the recent appointment of **William R. Gottshall** to manager of the tubular division with headquarters in Dallas, Texas.

Gottshall became associated with Continental at Shreveport, Louisiana, in 1936. While there he was selected to attend a special training course at the mills of The Youngstown Sheet and Tube Company.

Replacing Gottshall as assistant district manager at Oklahoma City is **Harold J. McMann,** formerly district credit manager for the Oklahoma-Kansas district.



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HALL-SCOTT POWER saves money!

The Hall-Scott V-12 is a versatile performer . . . for powering draw works, drilling rigs, pumps, generators, other industrial equipment.

This engine saves you money because of (1) exceptional power-to-weight ratio, (2) unit construction, which provides for quicker servicing with minimum downtime, (3) compact design, which means greater mobility, lower transportation costs.

Like the *Series 400* Hall-Scott Engine, the V-12 is adaptable to gasoline, butane, or natural gas operation. Full details on request.

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MOTOR DIVISION
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HALL POWER BY SCOTT

▸ Nine promotions of sales department officials in American Steel and Wire Company were announced recently by H. M. Francis, vice president-sales of this U. S. subsidiary. They are:

Norman M. Sted, manager of the manufacturers products sales division, at the company's headquarters in Cleveland, Ohio; **Maxwell D. V. Millard,** manager of the Detroit, Michigan, district sales office; and **Edward A. Murray,** manager of the Chicago, Illinois, district sales office.

Robert M. Page, manager of Worcester, Massachusetts district sales, succeeding F. Kenneth Sawyer, who retired on August 1 after 44 years of service with the company's sales department. **Paul Ketring,** director, cold rolled strip sales, at company headquarters in Cleveland. **Harry F. McAnerney,** assistant manager, manufacturers products sales division, at company headquarters, Cleveland. **James R. Mohr,** assistant manager, Detroit district sales. **Fred L. Nonnenmacher,** manager of manufacturers products sales, Chicago. **Frank T. Clarke,** manager of manufacturers products sales, New York.

▸ **J. E. (Jim) Meador** has been named district manager for the Rocky Mountain area, Baker Oil Tools, Inc.,

J. E. Meador

with headquarters at Casper, Wyoming.

Meador has been associated with Baker since July, 1943, in sales and service work principally in the Los Angeles Basin, where he has acquired a wide knowledge of Baker products and their application in well completion and production operations.

▸ **William J. Tunny** of Chicago, Illinois, has been appointed superintendent of electrical maintenance at the Indiana harbor plants of The Youngstown Sheet and Tube Company.

Tunny joined the company 30 years ago, working as tracer in the engineering department, motor inspector, wireman, electric shop work, electric testing engineer, chief electric testing engineer, and assistant electrical engineer for several years.

▸ The S. G. Taylor Chain Company, Hammond, Indiana, manufacturers of industrial and automotive tire chains,

S. N. Morison E. W. Chapman

has announced the promotion of **E. W. "Ted" Chapman** as assistant sales manager and **S. N. Morison** as manager of industrial sales. Chapman has been with Taylor Chain for 16 years. Morison has been a Taylor Chain man for 12 years.

▸ **G. W. Camblin,** vice president of Petrolite Corporation, Ltd., and general manager of the Tretolite Company of California division, and **F. L. Kelley,** vice president and director of the Petrolite Corporation, Ltd., were honored at a banquet at the Los Angeles Biltmore Hotel on July 15. Camblin's associates in the Tretolite of California division presented him with an oil painting. Kelley was the recipient of an engraved desk-pen set. Both men have over 25 years' service with the company.

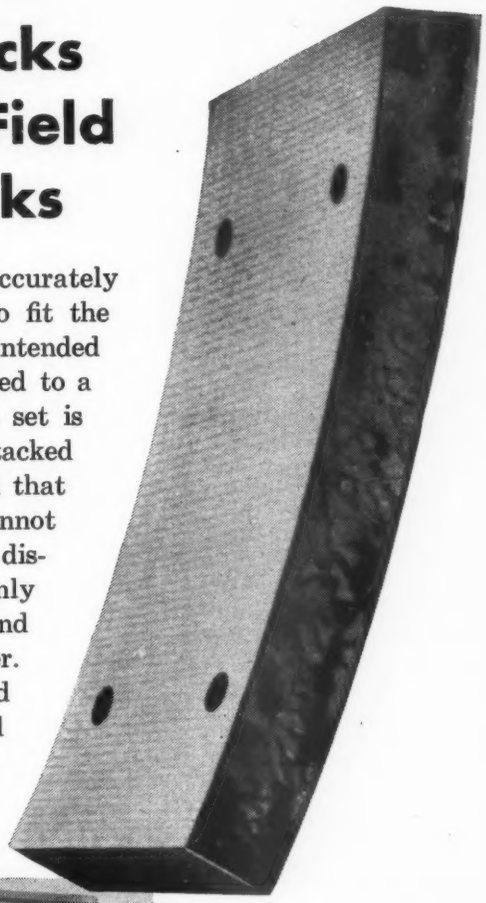
▸ **Cortlandt S. Dietler** has been appointed director and officer of Williams-Copeland, Inc., drilling contractors. Dietler was formerly Rocky Mountain representative for The Toronto Pipe Line Company in Casper, Wyoming. A native of Denver, Colorado, Dietler was graduated from Culver Military Academy and the University of Tulsa.

During World War II he served overseas 33 months with the Corps of Engineers. Immediately following graduation he was employed in the Middle East by the Trans-Arabian Pipe Line Company in its Government Relations Department.

▸ Dearborn Chemical Company has announced the addition of **W. E. (Easy) Pickens** to its pipe line department as a service engineer. Pickens has had wide experience in the application of rust preventives to pipe lines, having served in a supervisory capacity for such organizations as Sinclair Oil Company, Williams Brothers Corporation, Oklahoma Contracting Company, El Paso Natural Gas Company and G. G. Griffis Construction Company.

Specify Thermoid

Brake Blocks for ALL Oil Field Drawworks



Thermoid Blocks are accurately formed and jig drilled to fit the unit for which they are intended . . . relining time is reduced to a matter of minutes. Each set is packed with the blocks stacked on edge and so protected that the pre-formed radius cannot be changed or the blocks distorted in shipment. Only enough blocks for one band are packed in a container. Each box is clearly marked with the make and model number of the equipment to be serviced.

No matter what make or model drawworks you use, there is a "Packaged Set" of Thermoid Oil Field Brake Blocks manufactured specifically for your machine. These blocks are designed to provide top operating efficiency and long life, even under the most severe service conditions.

Thermoid Brake Lining is also available in roll lots. All Thermoid Brake Linings are built for the job . . . built to "feed-off" correctly . . . built to meet your special requirements.

It will pay you to *Specify* Thermoid!

Other Thermoid Quality Oil Field Products: Wire Line Turn Backs • No Wip Line Savers • Stuffing Box Rings • All types of Hose • Molded Specialties • Powerflex Rotary Hose • Mud-Flo Slush Pump Hose • Flexible Discharge Units • Brake Blocks

Thermoid Company

Western Offices and Factory · Nephi, Utah, U.S.A.

Main Offices and Factory · Trenton, N. J., U. S. A.

Industrial Rubber Products · Friction Materials · Oil Field Products

▸ **Forrest L. Ledlow,** secretary-treasurer of Thornhill-Craver Company, has resigned his position with

F. L. Ledlow

the Houston, Texas, manufacturing firm to accept the position of president of Aztec Ceramics, Inc., San Antonio.

Ledlow joined the Thornhill-Craver organization in 1937. He was in the accounting department of the company until 1945.

▸ **E. W. Riblett** has been transferred from the New York office of The M. W. Kellogg Company to Jersey City, New Jersey as associate director of the Petroleum and Chemical Research Laboratory.

▸ Schlumberger Well Surveying Corporation, Houston, Texas, has announced the transfer of **R. Legeron** from the company's headquarters to its Canada division where he will serve as manager. **C. W. Bailey,** former Schlumberger Manager in Canada, has been moved back to the company's operations in the United States. B. L. Delleney will continue as assistant manager in the Canada area.

R. D. Ford has been named manager of the Mid-Continent area with headquarters in Tulsa, Oklahoma. C. K. Ruddick is assistant manager of the Mid-Continent area.

▸ Bethlehem Supply Company announces the appointment of **Charles E. Medley** as a special representative. Medley will be located in Fort Worth, Texas, and will direct his efforts to the sale of pumping units and other production equipment for the entire company. A native of Tennessee, he attended the University of Tennessee, where he majored in mechanical engineering until he was called into the armed service in World War I. He became interested in the oil industry in 1926 and now has more than 20 years experience in the manufacture and sale of all types of oil field equipment.

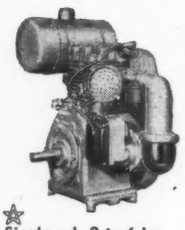
▸ **W. H. (Bill) Griffin** has been appointed sales manager of the Houston, Texas, branch of Welex Jet Services,

W. H. Griffin

Inc., R. C. Armstrong, president, has announced. The Houston branch was opened in May.

For the past 13 years Griffin has been associated with Baker Oil Tools, Inc., in Houston. As Baker's division engineer and manager of export sales he worked on special production problems in Venezuela, Trinidad, Colombia, and Western Canada. His research work has resulted in the design of various equipment now used by Baker Oil Tools, Inc.

AN ALL TIME RECORD FOR AN ALL STAR TEAM!



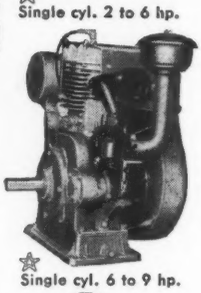
☆ Single cyl. 2 to 6 hp.

40.2% of All Carburetor Type Engines Built in 1947, 2 to 30 hp. Were WISCONSIN Heavy-Duty Air-Cooled ENGINES!

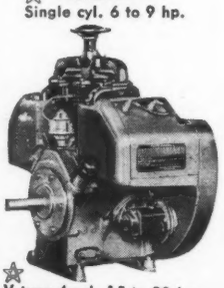
And here's the ALL STAR lineup . . . released in an official bulletin of the Bureau of Census, U. S. Dept., of Commerce, April 22, 1949.

In 1947, Wisconsin Motors built 51.7% of the engines in the 2 to 5 hp. range . . . in the 5 to 9 hp. range, 36.4% . . . 71.6% in the 15 to 22 hp. range . . . and in the 25 to 40 hp. range, 14.7%. Averaged together, 40.2% of the engines in the 2 to 30 hp. range were Wisconsins — excluding automotive, aircraft and outboard marine engines, and engines for use as original equipment by various manufacturers.

These figures sum up the confidence of equipment builders and users who are the final judges in choosing superior engines *where it counts most* . . . on the job delivering the goods.



☆ Single cyl. 6 to 9 hp.



☆ V-type 4-cyl. 15 to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

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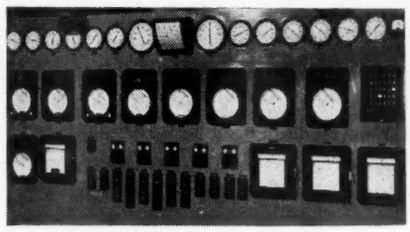
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.



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for the Oil Industry

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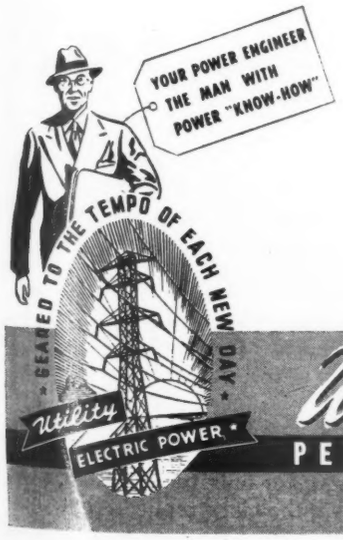


Use Utility Electric Power!

PETROLEUM ELECTRIC POWER ASSOCIATION

Box 1498, Oklahoma City, Oklahoma

LAUGH WITH BARNEY

With six guns blazing, a gangster strode into the saloon and ordered: "All you dirty bums get outa here."

Customers fled in a hail of bullets—except an Englishman who stood at the bar calmly sipping his drink.

"Well?" snapped the gangster, waving his guns.

"Well?" remarked the Englishman, "there certainly were a lot of them, weren't there?"

* * *

Son: Paw, does bigamy mean that a man has one wife too many?

Paw: Not necessarily. A man can have one wife too many and still not be a bigamist.

* * *

The artist kissed his model. "I bet you do that to all your models," she said.

"No," he replied. "You are the first."

"How many models have you had?"

"Four," he answered. "A rose, an onion, a banana and you."

* * *

"What I can't understand," observed the bailiff, "is how a jury composed of six young women and six young men can be locked up in a jury room for 12 hours and come out and say, 'Not guilty.'"

Then there was the one about the Cannibal king who said he couldn't play bridge, but he could throw up a good hand.

* * *

"What's a pedestrian, Daddy?"

"It's a man with a wife, a daughter, two sons, and one car."

* * *

A somewhat tipsy gentleman boarded a two-story bus in Chicago and sat near the driver who suggested that he go up to the top and enjoy the fresh air. The drunk went up. In a few minutes he was back. "What's the matter?" asked the driver. "Didn't you like it up there?"

"Fine view, good fresh air, but it's too dangerous. No driver."

* * *

Good resolutions are like babies crying in church—they should be carried out immediately.

* * *

Two boys who were returning on the street car from Sunday school a few days after Christmas were discussing the lesson of the morning: "Do you believe all that stuff about the devil?" one asked.

"Naw," replied the other boy. "It's just like Santa Claus: it's your old man."

DUNNO' WHAT'S AT 4732 FEET— BUT EVERYTIME WE REACH IT, THE CHART PEN SQUIRTS OIL ALL OVER THE CHART !!
LANE O WELLS
RADIOACTIVITY WELL LOGGING
HOPPIN
CR-204

Mandy: I can't come to work tomorow, Ma'am. My lil' boy is sick.

Ma'am: Why, Mandy, I thought you said you were an old maid.

Mandy: Ah is, Ma'am, but Ah aint one of dem fussy kind.

* * *

In the dark of night two safebreakers entered a bank. One approached the safe, sat down on the floor, took off his shoes and socks, and started to turn the dial of the safe with his toes.

"What's the matter?" said his pal; "let's open this thing and get out of here."

"Naw, it'll only take a minute longer, and we'll drive them fingerprint experts nuts."

* * *

"Why do you wear your stockings inside out?"

"My feet were so hot I turned the hose on 'em."

* * *

"Now," said the college man to his dad at the football game, "you'll see more excitement for two dollars than you ever saw before."

"I don't know about that," replied the old gent. "That's what I paid for my marriage license."

* * *

A guy wandering through a department store squeezed one doll and it cried "Mama." Later he squeezed another doll and it screamed "Floorwalker."

* * *

Speaking on the dangers of modern food, the speaker pointed a finger at a harassed looking listener and demanded, "What is it that we all eat, at some time or another, that is the worst thing imaginable for us? Do you know sir?"

Softly came the answer from the little man, "Wedding cake."

* * *

Maizie: I'm through with those college boys.

Daizie: Me too, they start out by holding your hand and pretty soon they're trying to shuffle the whole deck.

* * *

A traveling man was about to check in at a hotel in Hollywood when he noticed a most charming bit of femininity giving him the so-called "glad eye." In a very casual manner, he walked over and spoke to her as though he had known her for years. Both walked back to the desk and he registered as Mr. and Mrs.

After a two-day stay he checked out and was handed a bill for three hundred and fifty dollars. "There is a mistake here," he protested, "I have been here for only two days."

"Yes," the clerk replied, "but your wife has been here for two months."

METHODS USED IN ESTIMATING NATURAL GAS RESERVES

● **Methods of estimating associated gas reserves.** Certain additional problems are encountered in estimating associated gas reserves. First, the volume of gas that may be produced from the gas cap may exceed the original volume of gas contained in the gas cap because of migration of solution gas up structure with reduction of pressure on the oil zone. Second, the reservoir volume occupied by the gas cap may increase as oil is withdrawn or it may decrease due to movement of oil up structure. Third, the volume of gas produced from the gas cap may not be known accurately because some oil wells near the gas-oil contact may produce associated gas as well as dissolved gas.

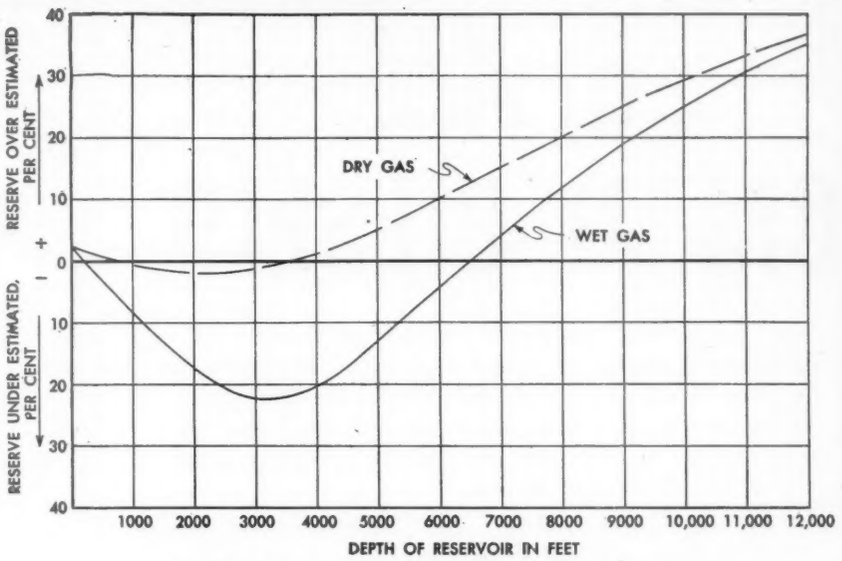
Decline curve methods for estimating the amount of gas remaining in a gas cap are inaccurate, for the volume of the reservoir will remain constant only under exceptional conditions and dissolved gas may migrate into the gas cap.

The problem of estimation is simplified if no effort is made to distinguish between associated and dissolved gas. The total original gas reserve may be computed and the cumulative production of associated and dissolved gas subtracted to obtain the total gas reserve remaining at any time.

● **Methods of estimating dissolved gas reserves.** The principal method of estimating dissolved gas reserves is a volumetric method. The original gas in place is determined by estimating the original volume of stock-tank oil in place, and multiplying this value by the original solution gas-oil ratio. The recovery factor to be applied depends on the mechanics under which the reservoir will be produced.

(1). *Water drive.* In the case of reservoirs in which the pressure does not drop below the bubble point, the gas-oil ratio will be constant and the recovery factor for gas will be the same as the recovery factor for oil. The East Texas field is an example of this type of reservoir.

In the case of reservoirs in which the pressure drops below the bubble point, the recovery factor for gas will be greater than the recovery factor for oil. In order to make an accurate determination of the recovery factor, it is necessary to predetermine the pressure history of the field by material-balance and water-influx calculations, or by extrapolating a curve of pressure against cumulative production, if rates of production have been constant. Having estimated the pressure history of the field the amount of gas to be recovered can be reasonably approximated by mutiplying the volume of recoverable oil by the original dissolved gas-oil ratio and adding an amount equal to the volume of unrecoverable oil times the difference in the original dissolved gas-oil ratio and the amount of gas in solution per barrel of oil at the average pressures at which the reservoir is expected to be produced.



CURVE 5. Per cent error resulting from omission of both temperature and compressibility factor.

(2) *Constant-volume type reservoir.* To calculate the amount of recoverable gas it is necessary to calculate the gas originally in place and subtract the gas that is calculated to be unrecoverable at the expected abandonment pressure of the reservoir. This may be calculated by the following equations:

$$R = O_p G_o - U$$

Where.

R = recoverable gas, cu ft,

U = unrecoverable gas, cu ft,

$$\text{or } (V - O_u\ Fv_a)\ 5.61\ \frac{(P_a)}{(P_b)} \times \frac{(520)}{(t+460)}\ \frac{(1)}{(Z_a)} + O_u\ G_a$$

V = void space in reservoir, bbl, or, $7758 \times \phi \times (1 - S_w)$,

O_u = unrecoverable oil in barrels at stock-tank conditions, or $(O_p - O_r)$,

O_p = original oil in place in bbl at stock-tank conditions, or $\frac{V}{Fv_o}$

O_r = recoverable oil in barrels at stock-tank conditions,

Fv_o = original formation volume factor,

P_a = reservoir pressure at abandonment, psia,

P_b = base pressure, in psia,

t = reservoir temperature, F,

Z_a = compressibility factor at P_a,

G_a = cu ft of gas measured at base pressure in solution per bbl of stock-tank oil at P_a, and

G_o = cu ft of gas measured at base pressure originally in solution per bbl of oil at stock-tank conditions.

● **Common errors in method of estimating natural gas reserves.** The following errors have been noted in reviewing natural gas reserve estimations:

1. Construction of a pressure curve for an early well in a field and application of the indicated reserve to later wells on a per-well or per-acre basis.

2. Construction of pressure-decline curves from arithmetic average pressures when well spacing is not uniform and the number of wells is not constant.

3. Construction of pressure-decline curves using pressures obtained from isobaric maps, all of which do not cover the same area.

4. Failure to check decline-curve-estimates by volumetric calculations to determine whether the area, thickness, and porosity required to contain the estimated reserve conflict with the available data.

5. Failure to consider the effect of deviation from Boyle's law.

6. Assuming that neglect of corrections for temperature and compressibility are compensating. (See Curve 5.)

Taken from the article, "A Critical Review of Methods Used in the Estimation of Natural Gas Reserves," by Henry J. Gruy and Jack A. Crichton of DeGolyer and MacNaughton, presented before the Tulsa, Oklahoma, and Los Angeles, California, meetings of the Petroleum Division, American Institute of Mining and Metallurgical Engineers, October 8-10 and 23-24, 1947, respectively, and published in *The Petroleum Engineer*, October, 1948, pages 208 to 220 inclusive.

These Vital Parts fit *ALL* GM "71" DIESELS

Every GM Series 71 Diesel engine, whether a two-cylinder or one of a Quad 6, *has the same bore and stroke.* This means that practically all moving parts are exactly the same for any size Series 71 engine from 43 to 520 continuous B.H.P.

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To large contractors, oil drillers, truck or boat fleet operators, this unique feature of GM Diesel design means lower parts inventories and less time out for maintenance.

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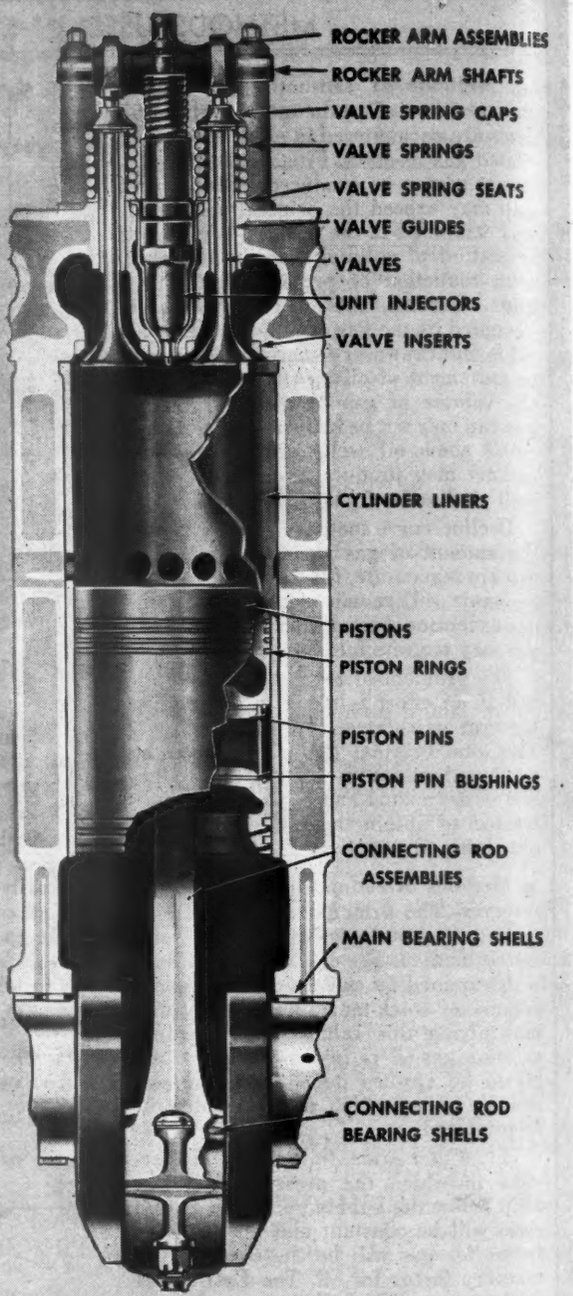
For topmost satisfaction and reliability, always buy genuine "Factory-Engineered" GM Diesel parts from your authorized distributor or dealer.



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Diesel Power Co. OKLAHOMA CITY, OKLAHOMA
Empire Machinery Co., Inc. ODESSA, TEXAS
West Coast Engine & Equip. Co. BERKELEY, CALIFORNIA
United Tool & Valve Repair Co. SHREVEPORT, LOUISIANA
Seitz Machinery Company Inc. BILLINGS, MONTANA
Stewart & Stevenson Services Inc. HOUSTON 11, TEXAS
Gehring Equipment Co. CASPER, WYOMING
Scranton Machine & Supply Co. GREAT BEND, KANSAS (Dealer)
Mountain Tractor Co. MISSOULA, MONTANA
Diesel Equipment Co. WICHITA, KANSAS
Haynes Machinery Co. PLAINVIEW, TEXAS

DESIGN OF A VAPOR SAVING SYSTEM

CALCULATIONS

1. Vapor flow due to tank breathing.
   (a) The total breathing rate is: I=2.4 (from Table 2) + 5.6 (from Table 3)=8.0 per cent expansion in one hour.
   (b) The flow for each size tank due to breathing alone:
   12,500 bbl×⅔×5.615×8%=3740 cfh
   25,000 bbl×⅔×5.615×8%=7480 cfh
2. Vapor flow due to combined breathing and pumping.
   (a) Flow from 12,500 bbl tank:
   Pumping 1000×5.615 = 5615 cfh
   Breathing = 3740
   Flow in line AB= 9355 cfh
   (b) Flow from 2—12,500 bbl tanks:
   Flow in line BD (2×9355) =18,710 cfh
   (c) Flow from 25,000 bbl tank:
   Pumping = 5615 cfh
   Breathing = 7480
   Flow in line CD =13,095 cfh
   (d) Combined flow from three tanks:
   Flow in line BD =18,710 cfh
   Breathing from 25,000-bbl tank = 7480
   Flow in line DE =26,190 cfh
3. Allowable pressure drop in vapor line.
   (a) The operating pressure of the lifter roof depends upon the weight of the movable portion of the roof and the horizontal area over which the tank pressure acts upwardly against the roof. For the 67-ft diam roof with a 10-ft lift the operating pressure is 5 in. of water. The pressure vents on the connected cone roof tanks are set 1½ in. of water higher or at 6½ in. of water. This will allow 1 in. of water pressure drop in the vapor line and leave a reserve of ½ in. of water to assure that the cone roof tank vents will remain closed tightly under operating conditions. The total pressure available to sustain vapor flow from any cone roof tank to the lifter roof tank is therefore 1 in. of water.

TABLE 5. Specific gravity for gasoline vapor and air mixture.

Per Cent Gasoline By Volume	0	10	20	30	40	50	60	70	80	90	100
Specific Gravity....	1.00	1.18	1.36	1.55	1.73	1.91	2.09	2.27	2.46	2.64	2.82

   (b) When vapor flow is from the lifter roof tank to the cone roof tanks the available pressure drop is always far in excess of the 1 in. of water established in (a) above. Therefore, this condition never need be taken into account in designing vapor lines for lifter roof systems.

The pipe sizes are computed by trial and error. It is first necessary to assume a reasonable size for each branch in order to determine the equivalent pipe length of all of the fittings in that branch. The results are tabulated as in Table 1.

Following are the calculations in detail for the 8-in. diam section, AB. The design flow is 9355 cu ft per hr and the specific gravity of the 40 per cent gasoline, 60 per cent air mixture (Table 5) is 1.73 referred to air. The total equivalent length is computed as follows:

1 entrance at 25 diam =1×25×8/12= 16 ft
2 90° elbows at 30 diam =2×30×8/12= 40 ft
1 tee at 90 diam =1×90×8/12= 60 ft
Actual length of pipe =295 ft
Total equivalent length of pipe =411 ft

Now using the chart, Sheet 5:

(1) Use a straight edge and make a straight line from 9355 on the "Q" scale at the left to 1.73 on the "S" scale at the right.
(2) Mark the point where this straight line crosses the pivot scale.
(2) Construct another straight line from 8 in. on the "d" scale at the left through the pivot point and read the intersection of this line on the "h/l" scale. In this example the intersection is at 0.084 indicating a pressure drop of 0.084 in. per 100 ft of pipe and equivalent fittings length. The total equivalent length is 411 ft and the pressure drop in section AB is as follows:

$$0.084\times\frac{411}{100}=0.35 \text{ in. of water}$$

The pressure is computed similarly for each section of pipe and in the final design the total pressure drop is 0.85 in. of water in the line AE and 0.88 in. in the line CE.

In working this example, it has been necessary to make certain assumptions regarding the product stored, the temperature variations, the degree of fullness of the tanks and the pumping rates. While it is believed that the assumptions used may be reasonable for a particular case, it is not recommended that the same assumptions be followed for other installations. Full information regarding the actual conditions of a proposed system should be obtained and the design made accordingly.

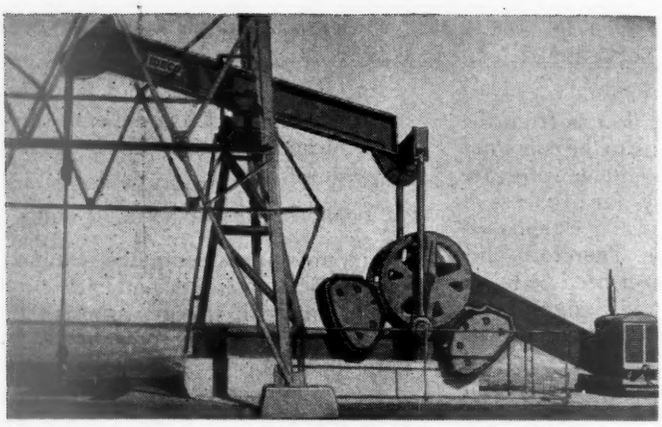
SPECIFYING THE TANK FITTINGS

All of the storage tanks in the system must be equipped with fittings that remain gastight. The standard types of pressure-vacuum vents commercially available will serve satisfactorily, provided they are inspected regularly and maintained properly. The gauging device should be of a type that will permit gauges to be taken without loss of vapor. It may be a float gauge or one of the gastight hand gauges on the market.

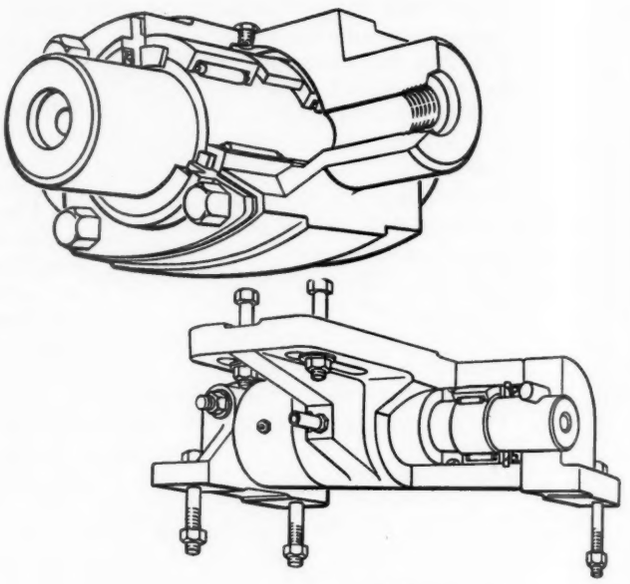
It is desirable to provide a pair of flanges and a spectacle line blind in each branch vapor line leading to a tank and in the main vapor line leading to the lifter roof tank. Line blinds are more economical and more positive than any type of valve for this service. They provide a simple means of isolating any given tank from the system when it is taken out of service for repairs or cleaning.

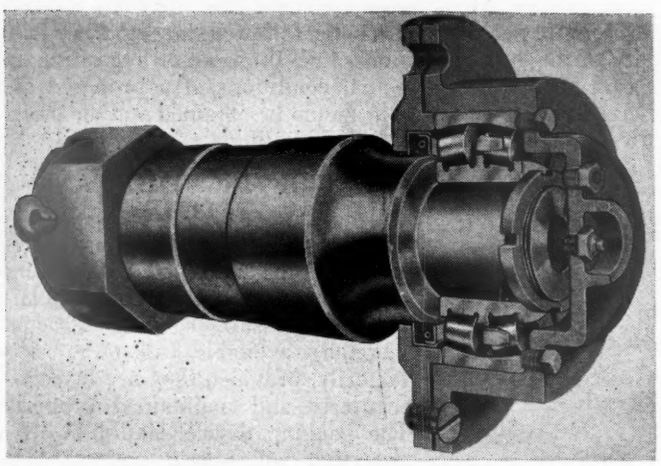
Taken from the Chicago Bridge and Iron Company's Bulletin C, "The Horton Lifter Roof," and reproduced by special permission.

Torrington Bearings give years of trouble-free service in IDECO geared pumpers

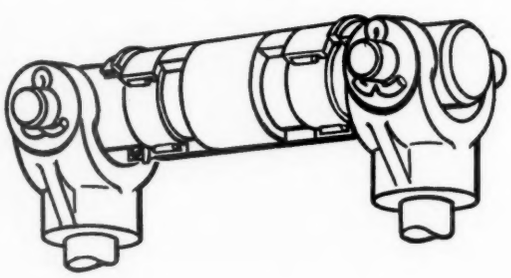


Familiar Sight in the oil fields is the steady, reliable "see-saw" of geared pumpers built by International Derrick and Equipment Co. Units built 21 years ago are still on the job. They have been made reliable by such features as Torrington Bearings in many critical applications.



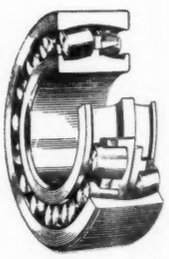


The Wrist Pin Assembly is a typical example. By incorporating a Torrington Spherical Roller Bearing, self-alignment becomes completely automatic. Deflection of the pitman in operation is also accommodated, and bearing cramping is avoided.



These Drawings illustrate the application of Torrington Type NCS Needle Bearings to IDECO equalizer, beam center and rein hanger assemblies. Several features of this bearing have led to its preference. Tremendous radial capacity is provided by its full complement of rollers. It operates directly on a hardened and ground shaft, making an unusually compact and economical assembly. Small diameter rollers assure even distribution of lubricant to all bearing surfaces, despite the difficult conditions of oscillating service.

Torrington Bearings have demonstrated their dependability by providing years of trouble-free service in all types of oil field equipment. Let our engineers help you secure the advantages of efficient operation and low maintenance assured by Torrington Bearings. Write us today. THE TORRINGTON COMPANY, South Bend 21, Ind., or Torrington, Conn. District offices and distributors in principal cities of United States and Canada.



TORRINGTON SPHERICAL ROLLER **BEARINGS**

Spherical Roller • Tapered Roller • Straight Roller

Needle • Ball • Needle Rollers

DATA ON MISSISSIPPI OIL AND GAS FIELDS.

Field	County	Discovery well	Discovery date	Reservoir	Range of production below ground feet	Range of API gravities of oil, degrees	No. of producing wells 6/30/49	Monthly oil production June, 1949 barrels	Cumulative production to 6/30/49 (1000 bbl)	Average value per barrel for month of June 1949
Amory	Monroe	Amory Pet. Co. No. 1 Carter	10/ 6/26	Hartselle–sandstone	2	gas	0	.....		Abandoned
Jackson Gas	Hinds & Rankin	Jackson Gas & Fuel	2/28/30	Selma ch–gas rock	2460	15	0	.....	17	Abandoned
Tinsley	Yazoo	No. 1 Mayes Kingwood Oil Co. No. 1 Wilburn	9/ 5/39	Selma ch Eutaw–U. Tusca	4455—5700	23 — 48	277	450,069	109,825	$2.459
Pickens	Madison & Yazoo	Union Prod. Co. No. 1 G. C. Woodruff	3/29/40	Wilburn sd Eutaw	4840	39 — 40	44	85,764	11,825	2.564
Cary	Sharkey	British-American No. A-1 Houston Est.	7/31/41	Selma ch –gas rock	3260	23	0	.....	60	Abandoned
Brookhaven	Lincoln	California Co. No. 1 G. T. Smith	3/10/43	Massive sd Basal Tusca	10136—10546	22 — 41	147	427,146	13,269	2.580
Eucutta	Wayne	Gulf Refining Co. No. 1 Aden Davis	9/ 3/43	Eutaw	4884—5307	18 — 34	123	140,849	11,056	1.884
Flora	Madison	Love Pet. Co. No. 2 Anderson	9/ 7/43	Selma ch gas rock	4337—4373	23 — 26	4	961	79	2.250
[1]Cranfield	Adams & Franklin	California Co. No. 1 Nat'l. Gasoline	10/ 4/43	Massive L. Tusca	4336—10476	38 — 56	98	462,166	21,428	2.743
Heidelberg	Jasper	Gulf Ref. Co. No. 1 Helen Morrison	1/27/44	Eutaw Tuscaloosa	4470— 5318	16 — 32	158	184,089	20,113	1.873
[2]Gwinville	Jeff. Davis & Simpson	S. W. Richardson No. 1 C. E. Berry	7/26/44	Eutaw U. Tusca	7734—9250	39 — 57	72	18,408	1,025	2.830
[1]Mallalieu	Lincoln	California Co. No. 1 W. C. Douglas	8/24/44	Massive L. Tusca	10366—10590	37 — 40	99	418,230	11,660	2.661
Baxterville	Lamar & Marion	Gulf Ref. Co. No. 1 C. V. Cooper	11/18/44	Tuscaloosa	7614— 8963	12 — 58	132	176,816	15,095	1.455
[3]Carthage Point	Adams	Pure Oil Co. No. 2 J. M. McDowell	1/13/45	Massive L. Tusca	10198—10285	49 — 57	10	38,356	1,334	2.850
Langsdale	Clarke	Kirby Pet. Co. No. B-1 Long Bell	1/18/45	Eutaw	3535—3809	19	33	26,055	1,315	1.810
[3]Soso	Jasper, Jones & Smith	Gulf Ref Co. No. 1 Edwards Bailey	3/ 1/45	Basal Eutaw	6448—6710	65 — 66	11	11,269	243	2.850
Hub	Marion	Humble Oil & Ref. No. 1 Evans	3/ 3/45	L. Tusca	7965—10106	34 — 56	22	23,729	639	2.618
Fayette	Jefferson	Humble Oil & Ref. No. 1 Smith	8/14/45	L. Tusca	9617—9813	37 — 43	9	14,317	625	2.678
Quitman	Clarke	L. T. Roussel et al No. 1 Long Bell	10/21/45	U. Eutaw	3658—3715	15	0	.....	4	.....
La Grange	Adams	Sohio-Roeser-Pendleton No. 1 Baker-Maier	2/18/46	Massive L. Tusca	4619—10549	35 — 46	125	378,888	6,294	2.695
Pine Ridge	Adams	Phillips Pet. Co. No. 1 Mrs. Vic Artman	12/ 8/46	Wilcox	5544—5622	40 — 41	9	29,352	415	2.700
Oldenburg	Franklin	J. C. Hawkins No. 1 Lehmann	10/16/47	L. Tusca	10538—10551	36 — 37	4	8,299	27	2.596
Yellow Creek	Wayne	Hughes & Sistrunk No. 1 G M & O RR	12/21/47	Eutaw	4782— 5218	18 — 20	53	67,170	1,232	1.791
Ovett	Jones	Gulf Ref. Co. No. 1 L. L. Majors	1/ 5/48	L. Tusca	12011—13082	32 — 34	1	1,490	42	2.540
Sandy Hook	Marion	Humble Oil & Ref. No. 2 E. R. Ford et al	7/20/48	Tuscaloosa	8979— 9039	53	1	.....	1	2.850
Roxie	Franklin	H. L. Hunt No. 1 W. L. Graves	12/ 6/48	L. Tusca	10578—10705	39 — 51	4	5,920	27	2.700
Bude	Franklin	Barndsdall Oil Co. No. 1 J. Pittman	2/ 1/49	L. Tusca	11090—11098	43	2	14,036	63	2.700
Sand Hill	Greene	Humble Oil & Ref. No. 1 F. J. Hubbard	4/25/49	U. Tusca	7804—7812	24	1	796	1	1.910
Ellisilie (Armstrong)	Adams	Sohio-Jones-Kemp No. 1 Geo. Armstrong	5/23/49	Wilcox	6467— 6472	36 — 37	1	2,803	4	2.404
TOTALS							1,421	2,989,017	227,633	

*Three one-well gas fields are not included—Bruinsburg, Claiborne County; Kings, Warren County; and McBride, Jefferson County.
[1]Large gas deposits with more than three billion cubic feet production per month.
[2]Large gas deposits with more than two billion cubic feet production per month.
[3]Gas deposits with almost a half billion cubic feet production per month.
[4]Gas deposits with almost a quarter billion cubic feet production per month.

EXTRACTION PLANT

CRANFIELD GAS CYCLING OPERATIONS
Adams and Franklin Counties, Mississippi
GAS PRODUCTION AND INTAKE VOLUME

	MAY 1949
Total gas from Lwr. Tusc. oil wells	2,444,167 MCF
Total gas from Lwr. Tusc. gas wells	356,006
Total gas from Paluxy formation (Adj.)	244,542
Less Lwr. Tusc. gas vented (outside oper., etc.)	4,327
Total gas to plant	3,040,388 MCF

DISPOSITION OF RESIDUE GAS

	May, 1949
Plant fuel	146,911 MCF
Returned for lease fuel	3,744
Sold or other disposition	11,889
Returned to Lwr. Tuscaloosa reservoir	2,731,500
Vented	36,767
Plant shrinkage	109,577
Total	3,040,388 MCF

PLANT PRODUCTION

	May, 1949
Crude oil & condensate	419,962 bbl
Gasoline	57,115
Propane	37,574
Total	514,651 bbl

REFINERY ACTIVITIES

REFINERS MONTHLY REPORT

	Southland Oil Inc., Rogers Lacy, Mississippi May, 1949	Paluxy Asphalt Co., Crupp Station, Mississippi May, 1949
Runs to stills, reruns, and/or blended:		
Crude oil	140,505 bbl	98,263 bbl
Kerosine	273	.....
Ethyl	21	47
Casinghead gasoline	3,402	4,163
Total	144,201 bbl	102,473 bbl
Products manufactured:		
Gasoline	19,812 bbl	38,596 bbl
Kerosine	.....	6,184
Gas-oil	49,634	6,358
Fuel oil	7,502	8,798
Asphalt	65,819	32,896
Processing losses	1,434	9,641
Total	144,201 bbl	102,473 bbl

Sure Sign

OF CONSISTENTLY EFFICIENT

EMULSION BREAKER

Call Capital 7309, Houston, Texas, collect, and immediate arrangements will be made for a Visco Field Representative to call. You will like Visco Field Service.

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building
Houston 1, Texas

Visco... **DEHYDRATING AND DESALTING CHEMICALS • WHEREVER COST AND EFFICIENCY COUNT**

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating compounds for use in the breaking and resolving of oil emulsions, and to grant licenses for such use, under the following United States patents: 1,860,662; 1,860,663; 1,912,330; 1,937,289; 2,050,629; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,812; 2,318,034; 2,318,035; 2,321,056; 2,355,654. Re. 20,717 and patents pending. Any purchaser of Visco Oil Treating compounds is authorized to use the same in the treating, breaking and resolving of oil emulsions in accordance with the above patents. The royalty for such use is included in the purchase price. Visco Products Company is authorized to and is willing to grant licenses on a royalty basis, to all companies, and to others desiring to practice the patented subject matter, under any and all of the above patents, permitting the user to purchase the oil treating compounds at will from any vendor, and to prepare the compounds for use under the above patent or patents, at a royalty charge of 20 cents per gallon. Application for license should be made to Visco Products Company, Houston, Texas.

new and improved machinery and equipment

A REGULAR FEATURE
appearing in
THE Petroleum Engineer
Irwin-Keasler Building
Dallas 1, Texas

(1) Hydraulic Dozer

Fred G. Johnson, general sales manager of Wm. Bros Boiler and Manufacturing Company, Minneapolis, Minnesota, has announced the new Bros power-plus hydraulic straight dozer designed for International TD-14 wide gauge tractors.

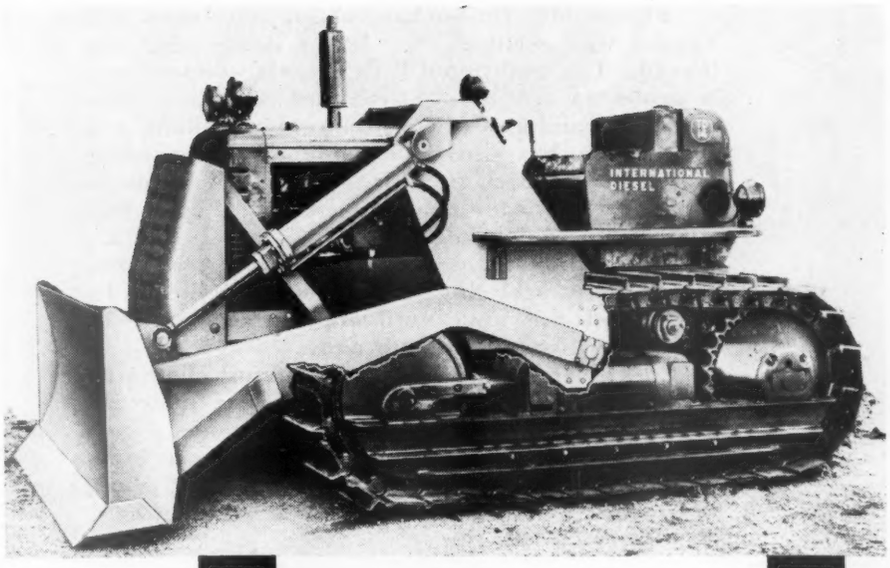
This new dozer is completely tractor-main-frame mounted, providing a standard gauge blade for a wide gauge tractor, making possible full utilization of tractor power without overload. (See cut at right.)

(2) Pump Valves

Especially designed for reciprocating pumps in such uses as pipe line and refinery service, the new valves and seats are furnished in bronze alloy with a special phenolic valve plate for operating temperatures up to 300 F and pressures up to 750 psi. For temperatures up to 950 F, this same design is available in stainless steel. The new valves are manufactured by American Iron and Machine Works Company, Olkahoma City, Oklahoma.

(3) Rotary Pumps

Worthington Pump and Machinery Corporation, Harrison, New Jersey, announces an improvement in design features on its rotary pumps by the incorporation of a new line known as GAMI. The new pumps employ the use of a mechanical seal and a self lubricating type inboard sleeve bearing to carry overhung drives. This seal and bearing assembly are interchangeable on the same shaft with the standard stuffing box of the GA type pump, so that if service conditions change, substitutions of seal or stuffing-box can be easily made.



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19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
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51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66		

NAME ..... TITLE .....

COMPANY NAME .....

STREET ADDRESS .....

CITY ..... ZONE NO. ..... STATE .....

WECO
FIGURE 602
UNION

THE TIME AND SPACE SAVING CHAMPION for
HIGH PRESSURE CONNECTIONS IN CLOSE QUARTERS . . .

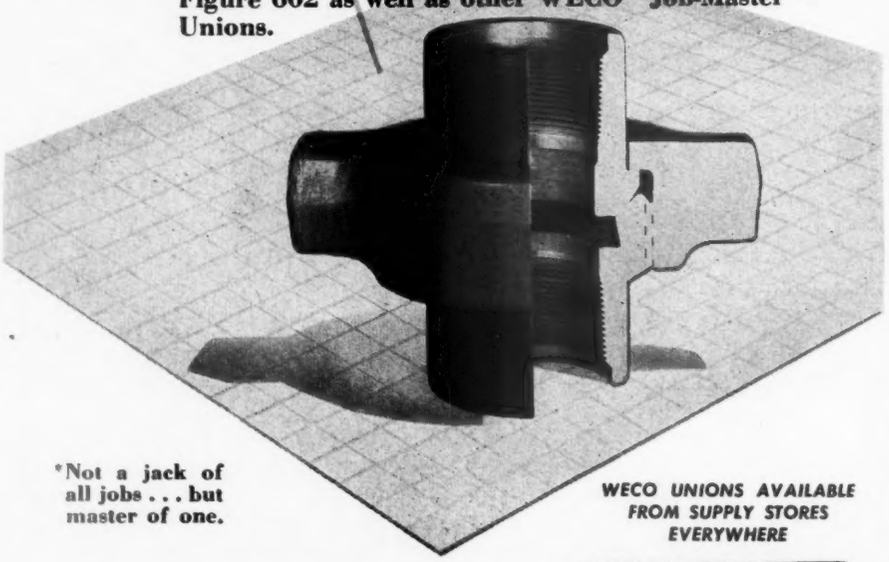
From sub end to sub end . . . from wing nut tip to wing nut tip, WECO Figure 602 Union is a champion in every respect. Designed for compactness, and retaining all the features of strength, speed and easy handling, perfect sealing, fast make-up, Figure 602 is ideal for high pressure connections in close quarters.

Figure 602 Union has forged steel subs with rugged wall sections . . . heavy Acme wing nut threads. The traditional WECO metal-to-metal seal is protected against abrasion and corrosion from line fluids and gases by a replaceable resilient seal ring which has proved capable of withstanding the extremely high pressures of the Oil Industry. With or without the resilient seal ring, Figure 602 gives you a perfect seal.

Figure 602 is ideal for welded installations. The resilient seal ring can be replaced simply by backing-off the wing nut, and the seal renewed without cutting off the sub ends.

Specify this time and space saving champion when making up connections in close quarters. It is available in sizes 1″ through 4″; has a cold working pressure of 3000 lbs. per square inch.

ASK YOUR WECO REPRESENTATIVE about Figure 602 as well as other WECO "Job-Master"* Unions.



*Not a jack of all jobs . . . but master of one.

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Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

WELL EQUIPMENT MFG. CORP.
Subsidiary of Chiksan Company
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CHIKSAN COMPANY
Brea, Calif. New York 7
Export Sales: CHIKSAN EXPORT COMPANY, Brea, Calif. New York 7

(4) Bolt Seal Gasket

Bolt seal gasket is not a new nor different gasket material but is a new style of bolt hole punching. Designed by C. D. Laidley Company, Tulsa, Oklahoma, it provides extra packing material sufficient to pack off bolt threads and the annular space in the tank sheets.

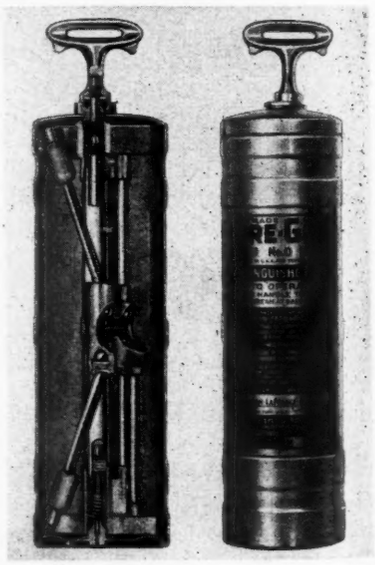
Ordinary punching requires a sufficiently large round hole to permit easy installation of the bolts. Thus, the threads are not packed and high bolt compression further reduces gasket around the threads and further enhances leaks. Bolt seal gasket provides a surplus of gasket material around the bolts and the first action in tightening the bolts is to flow this excess of gasket material into the bolt threads and annular spaces.

Major bolted tank suppliers are prepared to furnish bolted tanks equipped with this gasket.

(5) Tinning Process

American-LaFrance-Foamite Corporation, Elmira, New York, announces a new tinning process which doubles the life expectancy of the Alfco fire-gun (vaporizing liquid, pump type) fire extinguisher by protecting against internal corrosion.

Two forms of corrosion have been known to attack extinguishers of this type. Chemical acids may be formed



if moisture enters the unit, and the presence of dissimilar metals lends itself to an electrolytic action which leaches the zinc out of exposed brass surfaces. Tin plating eliminates both forms of corrosion.

The elimination of dissimilar metal surfaces means that electrolytic action will not take place. It is estimated that these advantages of tin plating will more than double the life of the extinguisher.

(6) Vacuum Seam Tester

A device for locating leaks in pipes, tanks, or other storage vessels is the patented American vacuum seam tester. The manufacturer, American Pipe and Steel Corporation, 2201 West Commonwealth Ave., Alhambra, California, reports that this compact, portable unit effects substantial savings by often eliminating the necessity of taking out of service the old equipment to be tested.

Testers are available in a wide variety of sizes and shapes for inside corners, outside corners, circumferential seams and straight seams.

Gasoline bulk plants and refineries equip their maintenance crews with vacuum seam testers to locate the pinhole leaks often caused by refinery chemicals, quickly rust-enlarged by moisture seepage. Testers thus prevent loss of valuable liquids and vapors, reduce possibility of expensive danger to employees, and add many extra years to tank life, states the manufacturer.

(7) Portable Pumping Unit

A new method of facilitating continuous pumping operations while overhauling stationary pipe line pumps has been devised by Stewart and Stevenson Services, Inc., 4516 Harrisburgh Blvd., Houston, Texas. It is a new streamlined, self-contained portable pipe line pumping unit utilizing a General Motors diesel quad and a high pressure pump—all mounted on a tandem trailer. A special removable trailer assembly and four screw jacks allow the unit to be lowered on a concrete foundation in any pipe line station where the stationary pumps are being overhauled or repaired.

The engine is a GM Quad Model 24103 furnished with built-in 1:1-2 stepup gear driving into another individual 1:2 stepup gear which is directly connected to the pump. The trailer forms a sub-base for the engine pumping unit when the tandem running gear has been removed.

The pump is an Ingersoll-Rand Model 6RT4. Intake capacity is 1800 gal per min, output capacity is 3600 gpm.

(8) Cement Head

Spartan Tool and Service Company, Houston, Texas, is now offering its customers the Rector "Fulbore" cement head. All of Spartan's cement camps will have Rector "Fulbore" cement heads for use with the conventional method, whether it be the one or two plug type and also the Rector "Fulbore" method.

The Rector cement head with its three cement inlets provides ample capacity to pump-in maximum volumes of cement regardless of method. It provides a positive means for dropping the trip ball, which ejects the float shoe assembly, and for releasing the two plugs with practically no shut down time. The head forms a closed circuit and provides shut in control at all times during cementing operations, states Frank Champion, president of Spartan.

(9) Torque Converter

The Axelson Manufacturing Company, Los Angeles, California, has recently acquired an exclusive manufacturing and sales license for the C. M. O'Leary patents on hydro-kinetic torque converter drives.

Designed for use with oil well drilling rigs, the first model, to be known as the "T-30," which is rated at a maximum of 600 hp at 900 RPM and a minimum of 350 hp at 800 RPM, is already in the process of manufacture.

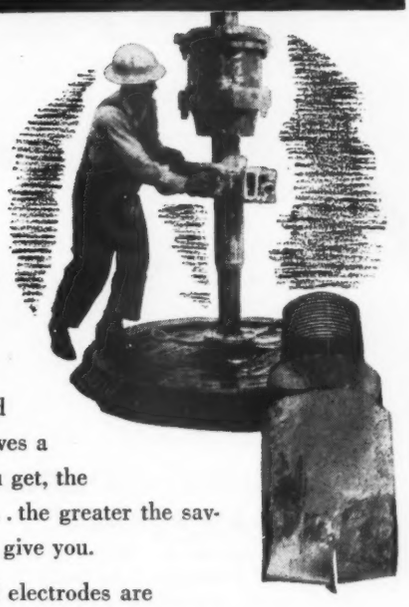
Future plans call for the torque converter to be built in four sizes for the petroleum drilling industry. Two high-speed types rated at 130 hp to 300 hp at 1600 RPM, and 250 hp to 575 hp at 1600 RPM; two low-speed types rated at 175 hp to 450 hp at 900 RPM, and the T-30 mentioned above.

FOR HARDFACING AND REPAIR

Amsco WELDING PRODUCTS

AMSCO TUNGSTEN CARBIDE HARDFACING

saves you money!



Drillers agree that the longer life of fish tail bits built-up with Amsco Tungsite Inserts and hardfaced with Tube Tungsite or Tungrod saves a lot in time and money. The further down you get, the greater the cost of changing worn out bits . . . the greater the savings Amsco tungsten carbide hardfacing can give you.

Amsco tungsten carbide welding rods and electrodes are available in a wide range of screen mesh sizes. Amsco Tungsite Inserts are supplied in twelve shapes and sizes for every type of bit. Get acquainted with Amsco Tube Tungsite and Tungrod.

Write for Bulletin W-C-75

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION

410 EAST 14th STREET · CHICAGO HEIGHTS, ILL.

Foundries at Chicago Heights, Ill., New Castle, Del., Denver, Colo., Oakland, Calif., Los Angeles, Calif., St. Louis, Mo. Offices in principal cities. Made and sold in Canada by Canadian Ramapo Division of Joliette Steel Ltd., Niagara Falls, Ont.

(10) Double Drum Winch

Wilson Manufacturing Company, Inc., Wichita Falls, Texas, announces its new super Torcair double drum winch. Truck mounted for quick portability and immediate operation, the winch is used for servicing wells up to 6000 ft with 2½ in. tubing.

The super Torcair winch is air controlled throughout. One valve controls both high and low drum clutches and engine throttle to operate the main drum while another valve controls the drum clutch and the engine throttle to operate the sand drum.

(11) Blanking Plug

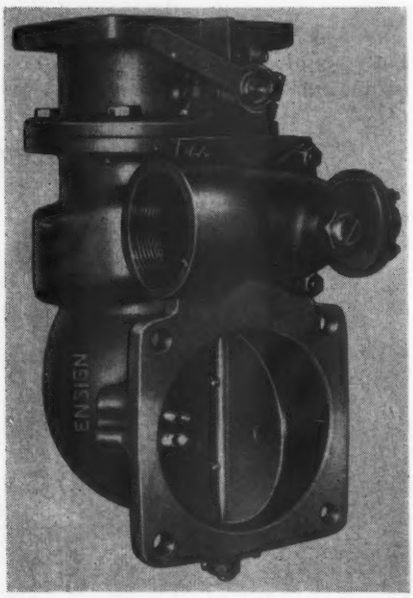
Yale Machine Works, 4403 Yale St., Houston, Texas, announces the manufacture of a new two-piece blanking plug union. Utilizing an oil-resistant O-Ring seal, this union consists of only two parts, a threaded sub end containing the O-Ring, for attaching to the line, and the blanking plug, which may be furnished blank or tapped for drain cock. It is designed for use on pipe line scrapper traps, jumper assemblies and manifolds.

The O-Ring will seal against all pressures or vacuum when the mating parts are snapped up hand tight.

Sizes from 1 in. through 16 in. are available, for working pressures as specified. In sizes up to 8 in., the blanking plug is connected to the sub end or line by a steel chain; sizes above 8 in. may be furnished with a chain, or with a hinged steel yoke, as specified.

(12) Carburetor

Ensign Carburetor Company, 7010 S. Alameda St., Huntington Park, California, has announced the manufacture of a new carburetor for natural gas and butane-propane. The Ensign model "Dg," was laid out in sizes ranging from 2½ in. to 4 in. to handle engines from 200 to 500 hp.



Outstanding features of the new "Dg" are: 1. Built-in fixed orifice economizer for part throttle operation, 2, instant starting, utilizing separate set of gas-air orifices, 3, provisions for balancing air-fuel ratios against air entrance losses, 4, interchangeable venturi for easy adaptation of carburetor to meet wide range of engine operating conditions, and 5, universal in application.

(13) Power Unit

Development of a new two-engine "power team," incorporating two Cummins dependable diesel engines mounted in one with hydraulic couplings, was recently announced by Cummins Sales and Service, Inc., Fort Worth, Texas.

The hydraulic couplings, which also tend to overcome inadequate torque at starting speeds, are extremely simple, both in principle and mechanics, it is asserted.

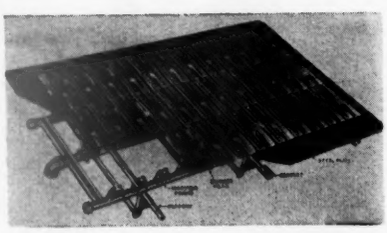
A choice of five Cummins dependable diesel engines is available for use in the assembly.

HENRY H. PARIS DISTRIBUTOR Inc.

Manufacturer's Agent - Oil Well and Refinery Supplies

P. O. BOX 932 — 1125 ROTHWELL ST.

HOUSTON, TEXAS



VOLCANO SUPERIOR GAS BURNERS

These burners derive their higher efficiency and longer life from such features as: All-steel construction; Burner heads with double barrel shank and double mixer are equivalent to two ordinary burner heads; Slight 11-shape of head assures more perfect combustion by proper circulation of secondary air; series of heads on triple manifold covers approximately entire firebox area. For superior efficiency, specify Volcano Superior Gas Burners.

Agent and Distributor for the following Nationally known Manufacturers:

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Quality Pumping Equipment, Swage Nipples, Bull Plugs, Welding Fittings, etc.

WHEELING MACHINE PRODUCTS CO.
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OIC VALVES, Bronze, Iron and Steel, for all purposes. "Oh! I see Lower Costs with OIC."

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OIL STATES EQUIPMENT COMPANY
Houston, Texas
OSECO Silvertop Fusible Plugs with renewable inserts for all types OIL COUNTRY BOILERS.

DRESSER MANUFACTURING DIV.
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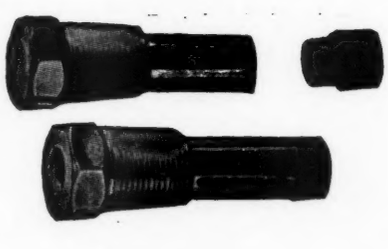
Seamless Welding Fittings.

WESTERN SAFETY BARREL STAND



OSECO High Pressure Fusible Plugs

Unique design permits replacement of inserts instead of the entire plug. OSECO "Silver Top" plugs are made in all standard sizes of best quality bronze, under A.S.M.E. specifications, for 300 and 350 lb. oil field boilers. They can also be furnished in Monel or Stainless Steel.

(14) Fluid-Motor Operation

Crane Company, Chicago, Illinois, has announced a simplified fluid-motor operator for gate valves. This new design makes possible extensive use of motor operated valves, since the actuating unit can be easily adapted to standard valves in stock or to valves already installed. The device can be operated by water, oil or compressed air or gases.

The motor unit, comprising the motor, gear box and yoke, is bolted to the valve bonnet; and the motor operates the valve stem through the gear box. The motor derives its power from five flexible diaphragms, mounted radially about an eccentric on the drive shaft. The operating fluid is admitted in rotational sequence to the five diaphragms, which actuate pistons that transmit the thrust to the eccentric through a roller bearing mounted on the shaft.

When the valve gate reaches the end of its travel in either direction, the motor merely stalls, still under pressure. There can be no leakage, and shut-off devices are unnecessary.

The valves can be operated by a wide range of liquids or gases at pressures from 40 to 300 psi.

Valves equipped with the new fluid-motor operator are available in most types of Crane iron-body gate valves in sizes 4 in. through 30 in. Development is in progress on a motor for valves of still larger sizes.

(15) Industrial Welder

A record low price on its new model 200 ampere a-c industrial type welder is announced by the Lincoln Electric Company, Cleveland, Ohio. "The Fleetwelder 200," a NEMA rated unit with plenty of reserve capacity over its rated maximum load of 250 amperes, is available at a cost of $180, less than $1 per ampere of NEMA rated output. Electrodes ranging in diameter size from 5/64-in. to ¼-in. may be used with it.

The compact design of the welder allows the entire unit to be enclosed in pressed steel case standing only 25 in. high. The patented reactor control eliminates dead air space which is normally needed for other types of control.

The unit is equipped with wheels for portability at no extra cost. Total weight is 319 lb.

(16) Snatch Block

McKissick Products Corporation, P. O. Box 2496, Tulsa, Oklahoma, has announced the manufacture of a new and improved champion snatch block, No. 422. The improved champion features the patented "speed nut," which eliminates all lower bolts, and greatly facilitates opening and closing of the block. There are no bolts to unscrew, pull out, and lose. Drop forged, selected steels, are used throughout in the block's construction.

Available in 6-in., 8-in., and 10-in. sheaves, and with ultimate hook capacities from 92,000 lb to 96,000 lb.

STURDYBILT

homes....proven satisfactory for 30 years

Southern Mill was a pioneer in manufacturing prefabricated houses for the oil industry. For thirty years these homes have met the most rigid requirements for portability, comfort, sturdiness, and economy. Before you buy any oil field housing, investigate STURDYBILT . . . first.

MANUFACTURERS OF SPECIAL MILLWORK: DISTRIBUTORS OF JOHNS-MANVILLE BUILDING MATERIALS; CURTIS WOODWORK

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trade literature

PUBLICATIONS LISTED ARE SENT FREE UPON REQUEST

(17) Regulating Valves

The Minneapolis-Honeywell Regulator Company, Belfield Valve Division, Philadelphia, Pennsylvania, offers Bulletin No. 47-1 on regulating valves, for the purpose of acquainting users in general with the merits in the design of the FB valve, which is used in many applications in the process industries and other industries such as paper mills, dye houses, and tanneries.

Since the FB valves are made in four general classes, Bulletin No. 47-1 also contains information on the slip-stem and rotary shaft types for steam, air and gas; the slip-stem and rotary shaft types for liquids.

(18) Pipe Protection

Hill, Hubbell and Company, Division of General Paint Corporation, 2627 Army Street, Rincon Annex, San Francisco, California, has issued a new book that tells latest advances in pipe protection methods.

This book is illustrated with on-the-job photographs. The text is brief but carefully documented, and explains the processes of coating and wrapping that assure longest, most efficient protection for pipe line installation. Subject matter includes plant storage, the why of preheating, cleaning, coating and wrapping applications, inspection methods, delivery scheduling, load unit-shipping, and field handling.

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Air-Conditioned

You'll enjoy a cool visit to the 100% air-conditioned Rice Hotel, now more than ever . . .

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All rooms newly modernized . . . Four fine restaurants . . . 1,000-car garage . . . Central downtown location . . . Reasonable rates, from $4 single and from $6 double.

Home of beautiful EMPIRE ROOM, exquisite setting for dining and dancing to nationally famous orchestras.

THE RICE HOTEL

HOUSTON, TEXAS — R. BRUCE CARTER, *Management*

(19) General Catalog

Cardwell Manufacturing Company, Inc., Wichita 1, Kansas, have just published a new general catalog covering all Cardwell equipment.

This catalog consists of sixty pages and combines all of the separate catalogs for the various models into one general catalog, also, complete information on all current models. The new sixty-page general catalog is known as Catalog No. Fifty.

(20) Jacket Water Coolers

Young Radiator Company, Racine, Wisconsin, and Mattoon, Illinois, announces the issuance of Catalog No. 1349 covering its complete line of jacket water coolers for gas, gasoline, and diesel engine cooling.

This is a compact, low-cost unit, which the manufacturer states has been especially designed for cooling the jacket water of gas and Diesel pumping engines of about 40 hp.

Catalog No. 1349 also illustrates and describes the complete line of Young jacket water cooler accessories including details on the three types of cores available for water, oil, or gas cooling.

(21) Check Valve

A four page booklet has been distributed by Falcon Products, Inc., Pomona, California. The booklet features a vertical swing, horizontal check valve, designed to eliminate "chattering." This valve is a general purpose, high pressure, swing-check unit, suitable for use in the handling of oil, gas, steam, water, etc.

Actual applications are illustrated in the booklet and cutaway drawings show the internal structure and mode of operation. Also described and illustrated is a safety valve for automatic and instantaneous closing in case of fire. This valve may also be operated, either manually or automatically, by remote control.

(22) Heat Transfer Equipment

The Patterson-Kelley Company, Inc., East Stroudsburg, Pennsylvania, has issued a 4-page omnibus folder summarizing its activities in the broad field of heat transfer equipment such as kettles, heat exchangers, instantaneous heaters, condensers and coolers.

(23) Silent Chain Drives

A new, 36-page illustrated Book No. 2065 on Link-Belt silent chain drives for automotive and industrial engines, busses and trucks, has been published by Link-Belt Company, 307 North Michigan Avenue, Chicago, Illinois.

Engineers will find the data in this book helpful in designing cam shaft drives for internal combustion engines, and in laying out efficient driving connections between all types of shafts, compressors, pumps, blowers, generators, etc.

The new book is complete with tables of dimensions, center distances, pitch diameters of wheels, horsepower tables, data for calculating chain drive centers, chain length required for drives, etc.

(24) Turbine Pumps

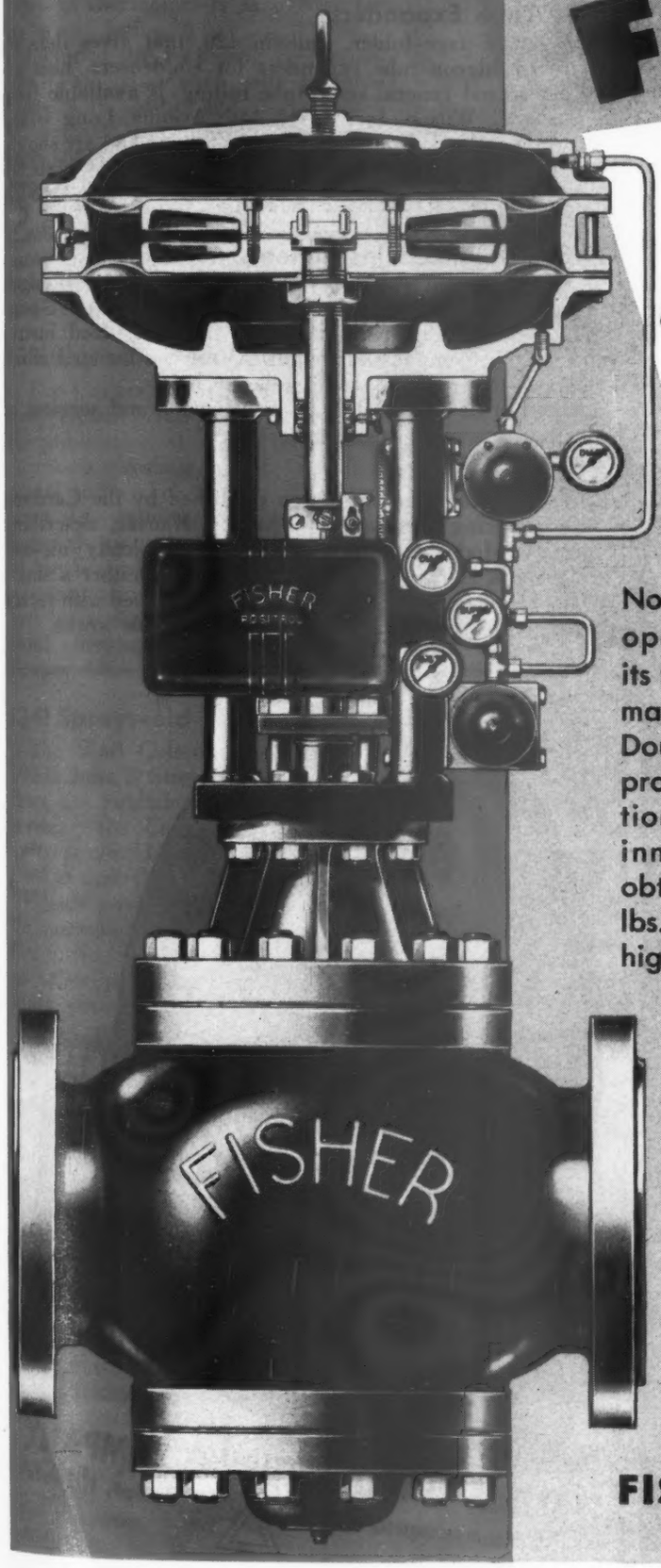
A Johnston Turbine Pump for every water transfer job in the wide ramification of industrial operations, is the theme of two booklets recently released by the Johnston Pump Company, Los Angeles, California. The text deals with the many applications for which Johnston Turbine Pumps are designed; explains how interchangeability of parts still further extends their utility and economy; and by means of sectional drawings shows the component parts of the pumps, their relation to each other, and the modus operandi of the complete mechanism. Bulletin 1013 treats of the Johnston oil lubricated pumps, and Bulletin 1014 explains the Johnston water lubricated pump.

A GIANT AMONG GIANTS

FISHER

*AMT

DIAPHRAGM MOTOR VALVES



Now, stem thrust power up to 5000 lbs. for opening or closing at any point within its travel range. Full pneumatic performance. No springs, no levers or weights. Double diaphragm avoids backlash effects probable with single diaphragm construction. Fisher Positrol accurately positions inner valve. In action, performance obtained with operating pressure up to 30 lbs. Designed for fast stroke action and high stability.

Why? Gives extreme power to actuate large single-seated valves for tight shut-off on large pressure drops up to 5000 pounds unbalanced forces.

*AMT

"ANSWER ME TWICE" IN ACTION.
PRESSURE **ADDED** TO ONE DIAPHRAGM,
SUBTRACTED FROM OTHER.

Write today for Bulletin 5700

FISHER GOVERNOR CO.
MARSHALLTOWN, IOWA

(25) Actuating Cylinders

Hydraulic actuating cylinders for the operation of gate valves are discussed in a technical bulletin released by Ledeen Manufacturing Company. Application of these cylinders to hot oil lines in refinery work is covered, along with cylinder details and installation information.

For copies write Ledeen Manufacturing Company, 1600 South San Pedro, Los Angeles 15, California. Ask for Bulletin CS-1049.

(26) Torque Converter Rig

Bulletin H-7-11-49 describing in detail the Hydrair 7-11, largest hydraulic torque converter rig in the Hydrair line has just been published by the International Derrick and Equipment Company, Dallas, Texas. This bulletin is liberally illustrated with drawings and photographs accompanied by performance data and specifications. Additional information contained in the bulletin deals with hydraulic torque converters, air clutches and air controls.

(27) Centrifugal Pumps

Four main types covering 26 basic series of Marlow self-priming centrifugal pumps are described and illustrated in a new bulletin just released by Marlow Pumps, Ridgewood, New Jersey.

Opening with a comparison of the different kinds of centrifugal pumps and a check list for selection guidance, the bulletin fully covers the new Marlow line of self-priming centrifugals which has been expanded.

The bulletin outlines the Marlow engine-driven self-primers and the diaphragm and plunger pumps. Another feature of the bulletin is the section devoted to general information on industrial pump installation and a typical example of the procedure used in engineering an installation.

Copies of this latest Marlow industrial pump booklet, called Bulletin IB49, may be obtained from manufacturer.

(28) National Sections

The National Radiator Company, Johnstown, Pennsylvania, has published a new catalog, Catalog No. HT 20 on national sections. National sections were designed for the condensing and cooling requirements of process industries. Purpose of this booklet is to present information which will afford users of condensing and cooling equipment an opportunity to determine how well national sections have met these important requisites.

(29) Tube Expanders

A new 6-page folder, Bulletin 420, that gives data on Wilson-Dudgeon tube expanders for condensers, heat exchangers and general small tube rolling, is available from Thomas C. Wilson, Inc., 21-11 44th Avenue, Long Island City 1, New York. Four models, 41, 42, 43 and 44 are shown.

Also illustrated is a complete line of tools and wrenches for heat exchanger tube assembly as well as various models of Wilson tube cleaners.

(30) Specialized Instruments

Sperry-Sun Well Surveying Company, 3118 Blodgett Avenue, Houston, Texas, has recently issued an 8-page catalog describing and illustrating the specialized instruments of the company and telling the story of the specialized Sperry-Sun services to the oil industry.

Covered in this catalog are instruments and services of interest to operating personnel.

(31) Drawworks

A new catalog has just been published by the Cardwell Manufacturing Company, Wichita 1, Kansas, describing its new Model L drawworks. This completely air-controlled unit is available as a simple hoist in either a single or double drum version, as well as fully equipped with rotary drive, automatic cathead, etc. for use as a draw works.

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(32) Thermometers

A new descriptive folder on Auto-Lite indicating and recording thermometers is now available from The Electric Auto-Lite Company, the Instrument and Gauge Division, Toledo, Ohio.

The folder contains descriptions and specifications for five different types of thermometers as well as for bulbs and fittings.

Included are recording thermometers, both stationary and portable types with 24-hr and 7-day clock movements; dial indicating thermometers with solid liquid filled and vapor tension actuated movements suitable for refrigeration, food and candy manufacture, and other industrial uses; and several types of indicating thermometers for food freezer and similar units.

(33) Corrosion Resistance

The Cooper Alloy Foundry Company, Hillside, New Jersey, announces the publication of a new bulletin on corrosion resistance of stainless, monel and nickel castings. This data sheet was designed primarily to aid materials engineers in their selection of the best alloy when the corrosive agents and conditions are known. The bulletin was prepared by N. S. Mott, chief chemist and metallurgist, The Cooper Alloy Foundry Company.

(34) Sprayweld Catalog

The Wall Colmonoy Corporation, 19345 John R Street, Detroit 3, Michigan, has published a new catalog describing the Colmonoy spraywelder and sprayweld process. This 4-page booklet describes the Colmonoy spraywelder, a powder metallizing gun, and the spraying of powdered Colmonoy No. 6. No. 5, and No. 4 alloys as well as other powdered metals, such as brass, copper, zinc, etc.

It is pointed out that the spraywelder can be used for metallizing as well as for the regular Colmonoy process which combines both welding and metallizing. Several of the hard facing applications which have proven most adaptable to spraywelding are also included. Numerous photographs illustrate the spraywelder, the sprayweld process and a few applications.

(35) Truck Pumps

Blackmer Pump Company describes the new single and dual (split load) truck pumps in a new four-page folder. Complete specifications and application data are included in this literature available on request to Blackmer Pump Company, 1809 Century Avenue, S.W., Grand Rapids. Michigan.

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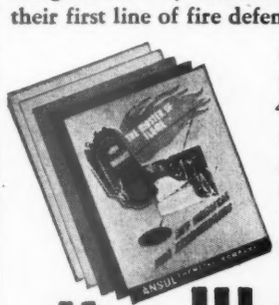

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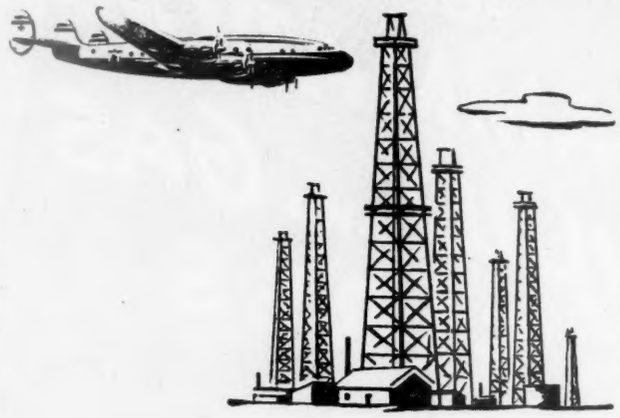

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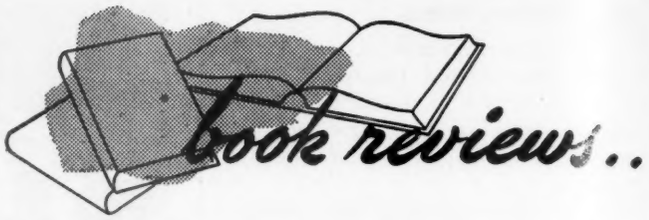

▸ **Handbook of Chemistry and Physics,** *Charles D. Hodgman, M. S., Editor in Chief, Chemical Rubber Publishing Company, 2310 Superior Avenue N.E., Cleveland, Ohio. Pages, 2737. Price, $6.*

This, the 31st edition of the Handbook, is systematically divided into five main sections. Each section is fully indexed, and includes: Mathematical tables, properties and physical constants of elements, inorganic compounds, general chemical tables, and quantities and units. This edition was edited by Hodgman, in collaboration with 181 scientists, specialists in their own field of activity. A great deal of new information has been added to this latest edition. As an aid in the study of nuclear physics, the table of isotopic masses as well as the table of wave lengths have been added.

▸ **Elements of Mechanical Vibration,** *Second Edition, by C. R. Freberg and Emory N. Kemler, John Wiley & Sons, Inc., New York, New York, Chapman & Hall, Ltd., London, England. Pages, 227. Price, $3.75.*

This second edition has gained two new chapters—Sound and Beams. The increased emphasis which engineers must give to noise elimination make this new chapter on sound and its applications an important one. As beams are a very common structural element, the authors have given them added emphasis by combining the previous discussion with new material and presenting it as a separate chapter. This edition, like the first, lays stress on the simple treatment of problems from a basic analysis.

▸ **Oil Maps of South Texas Counties,** *by Ira Rinehart. The Rinehart Oil News Company, P. O. Box 1208, Dallas, Texas.*

Oil and gas maps shown in this booklet appeared originally in Rinehart's *South Texas Oil*, a study of the petroleum industry in 31 counties of the Rio Grande embayment. The maps contain data as of September 1948.

▸ **New Mexico Oil and Gas Statistical Data for 1948,** *Department of the School of Mines, New Mexico Bureau of Mines and Mineral Resources, compiled by E. E. Kinney. Pages, 367. Price, $2.25.*

The 1948 statistical and engineering report includes oil and gas production and engineering data on all pools in the state of New Mexico. The compilation of these data is prepared as a service to the oil and gas industries of New Mexico.

▸ **The Physical Principles of Gas Liquefaction and Low Temperature Rectification,** *by Mansel Davies. Longmans, Green and Company, London, England, New York, New York, and Toronto, Canada. Pages, 205. Price, $6.25.*

This book discusses the fundamental aspects of gas liquefaction and the fractional distillation of liquefied gases. The theoretical sections are interwoven with descriptive material and cover the different processes in industrial use at the present time. The processes developed aim at both the extraction of chemically valuable gases from any source of industrial significance, and at the most effective utilization of coal and petroleum by treating them so as to obtain the maximum fuel value and to isolate the chemically important constituents that are available.